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143

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SANDAL.

Santalum album occurs in Mysore more or less abundantly all over the plateau, rarely outside it: rainfall limits of 30 and 50 inches, and elevations above 2,000 and below 4,000 feet. Geographically its area of distribution may be divided into three tracts:—

1*st.* The western Sandal zone.
2*nd.* The central scrubs.
3*rd.* The hill forests.

1*st.* The western zone of low forest is a well marked tract, eastward of and over-lapping the coffee and (more south) the teak zone. It is limited on the west directly by a rainfall too heavy for Sandal; and indirectly, by the jungle fires which increase in severity, going west, with the increased growth of grass resulting from the increased rainfall. This zone is limited, on the east, by a rainfall tailing down to 25 inches. Sandal is absent in the dry north central portion of Mysore, where the rainfall does not exceed 20 inches.

2*nd.* The stretches of dry scrubby forests, situated generally on poor gravelly soils, but sometimes on rich deep loams, which are found in the central and eastern portions of the plateau. The Sandal here is often abundant, there being little grass and light fires; but it is of the poorest quality. Where these scrubs are cultivated or much used for grazing, Sandal disappears entirely.

3*rd.* The ranges of gneiss hills which occur throughout the Mysore country, hills which in height rarely exceed 1,000 feet, and occur sometimes isolated, but usually in ill-defined ranges, running north and south. Many of these hills are rounded masses of solid granite, off which the tropical rain rushes as from the pent roof of a house, to the great benefit of the country around the hills. Suppose, for example, the area of a series of valleys is equal to that of the massive rocky portion of the hills, we have then a doubling of the rainfall for these valleys, and of course a marked improvement in the appearance

of forest vegetation. These hill forests are characterized by patches of nearly evergreen high timber forests, but also by bad grass and bad fires.

Speaking generally the Sandal in the central hill forests of Mysore is of good quality, but natural reproduction is often entirely suppressed by the severity of the forest fires. A remarkable instance of this occurs in the Modgerri State forest, situated 60 miles north of Bangalore, where, over an area of 27 square miles, Sandal is entirely excluded by severe annual fires. In the village grazing lands bordering this forest, where the grazing prevents fires, Sandal is abundant, especially in situations where there is also protection from cattle, such as clumps of thorns. Again, among the hills generally some fine specimens of Sandal are often observed growing in clefts of bare granite-like fig trees; in situations where there is too little surface soil for grass to grow, and where consequently the Sandal is out of the reach of fire. On the summits of the higher hills Sandal benefits by the temperate equable climate which characterizes slight elevations above the plateau; at lower elevations among the hill ranges Sandal profits by the extra rainfall resulting from the rush of water off the bare hills. Sandal from the central hill forests of Mysore is little inferior in quality to that from the regular Sandal zone of the west, but it is less abundant owing to a less easy reproduction.

II. *Requirements as to climate.*—The temperature of the western Sandal zone differs little from that of Bangalore. The northern portion of this zone is slightly lower in elevation; the central portion bordering the coffee districts of Nagor and Manzerabad is the same elevation as Bangalore; the southern portion bordering the teak forests nearly 1,000 feet lower. The central portion of the western Sandal zone has a general elevation of 3,000 feet, and a climate a few degrees cooler than that of Bangalore. The northern and southern portions of the Sandal zone have a temperature very little below that of Bangalore, because although nearly 1,000 feet lower in elevation they lie nearer the edge of the plateau, the ocean, and the prevailing south-west winds. Being nearer, the south-west monsoon lowers the temperature markedly from June to September. Being nearer the ocean and the edge of the plateau gives them the benefit of the sea breeze which alternates daily, after sundown, with the hot wind from the north-east, during the months of March, April and May. The mean temperature of the central hill forests varies within small limits according to elevation. With rare exceptions, the elevation of the lowest valley does not fall below 2,000 feet, nor the highest hill exceed 4,000 feet. The valleys at the lowest limit have a mean temperature of 6 or 8 degrees Fah. above that of Bangalore, and the climate is relatively brusquer, hot winds prevailing by day with cold nights from the downpour of cold air from the hill tops. The hills

have a climate more equable than that of Bangalore, the warm land-heated wind by day being cooled by expansion as it rushes up the hill sides, and the usually still night air (chilled by radiation) flowing off on all sides as fast as it cools. The mean temperature of the hill tops is, according to elevation, at the rate of about one degree Fah. lower for every 150 feet of rise above the level of the plateau. This, I am aware, is double the usual fall of temperature assigned for a similar elevation, but it is derived from observations taken on the Bakabudens, Nandidrúg, Rámandrúg and Dévaraiyadrúg hills. It is well known that the fall in temperature on ascending isolated hills is far greater than that between two plateaux at different elevations. The difference in mean temperature between Madras and Bangalore, for instance, two places situated on plains, one at 3,000 feet elevation and the other at sea level, is 9° Fah., or one degree per 300 feet elevation. But the difference between the mean temperature of Bangalore and that of a well known hill top (Nandidrúg) near Bangalore, and 1,800 feet above Bangalore, is 12°, which equals a fall of *one degree* in mean temperature per *150 feet of elevation.**

In the third Sandal tract, the flat scrubs, the climate is that of Bangalore, allowing for a slight rise of temperature, as the elevation falls from 3,000 feet to 2,000 feet. The following is a description of the climate of Bangalore, extracted from the Gazetteer of Mysore, from Blanford's Meteorology, and from various notes in my possession.

Climate of Bangalore—Temperature.—The mean temperature is 73°, the mean daily range (Puckle's tables) 15°, varying from 12° in July to 20° in February, though it is probable that these last figures are somewhat too low. Between the wet and dry bulbs of the thermometer (at 3-30 P.M. the hottest time of the day) the mean difference varies from 18° in March to 9° from July to October. The mean monthly maximum varies from 88° in April to 75° in December. From August to October, the three wettest months, the mean maximum is 79°. The mean monthly minimum varies from 59° in January to 70° in April: that of the three wettest months is 66°. The following table, compiled from Blanford's Indian Meteorologist, from Puckle's tables, and from the Mysore Gazetteer, gives averages of temperature, of range, of humidity and of rainfall for each month of the year. By 'range' is to be understood the average variation of temperature within the 24 hours, by humidity or dryness of air the average difference between the wet and dry bulbs of the thermometer at 3-30, which is taken as the maximum temperature of the day:—

* The diminution of temperature due to increased elevation is even more marked at Ajmere in Rajputana, where there is a fall of about one degree Fah. for every 100 feet of rise.—[ED].

Months.	Mean temperature	Diurnal range	Rainfall.	Dryness of air.
January, ...	67·4	18	0 00	13
February, ...	70·8	20	0·14	16
March, ...	77·4	20	1·25	18
April, ...	80·4	18	1·42	17
May,...	78·5	18	3 89	14
June, ...	75·1	15	3 97	11
July,...	72·4	12	4·10	10
August, ...	72·2	13	5·84	9
September, ...	72 8	14	5·95	9
October, ...	73 4	12	7 07	9
November, ...	70 7	13	1·05	10
December, ...	67 3	15	0·58	10
Yearly average, ...	73·2	15	35·	12

The regular south-west monsoon blows from June to September, both months inclusive, and gives an average rainfall of 23·75 inches. The north-east monsoon prevails more or less throughout the rest of the year. October is the wettest month of the year, with light variable winds (at Ooty the north-east monsoon is considered to set in about the middle of October). In November there is little wind, but it gradually draws round to the north-east. October with 7 inches of rain and November with 1 inch finish the regular rains. From December to the end of April, both months included, is the settled dry season, producing only 3·39 inches, and this in variable tropical showers. The wind blows from the north-east strongly during the day: the nights are still or with light airs; but a strong south-west current continues to blow intermittently at night, in the upper atmosphere, although it is scarcely felt at Bangalore. There is little wind in May, and the rainfall is usually confined to a few thunder showers, but the south-west monsoon sets in during the month, (generally quite at the end, but sometimes earlier,) and this fact, together with cyclonic falls of sometimes as much as 15 inches, give an average rainfall, equal on paper, to that of a month during the regular rains. But nothing more than a few showers can be depended upon in May, and the spring time of the year for vegetation in Mysore is the month of June, when, as will be seen from a reference to the table, the temperature, range, and dryness of the air fall, almost at once, from their hot weather maxima to the average for the year. But the rainfall, it will be observed, is considerably below the average for the wet months, and herein lies a great obstacle to the success of artificial sowings and plantings, and also to natural

reproduction over the greater part of Mysore. In western Mysore, within the Sandal zone, where the total rainfall does not exceed that of Bangalore, but where the early rains are the more copious, natural reproduction is observably better.

Alternation of Seasons.—Frost in Mysore is unknown; rarely, and in certain situations, minimum air readings of the thermometer have been obtained as low as 32° Fah., but this is purely a meteorological curiosity; and similarly, an honest shade temperature of 100° Fah. is phenomenal. Looking at the table, it will be seen that the marked characteristic of the climate of Mysore is its equability, and for vegetation this equability is even more marked, since as there is no rain in the cold weather, the increased heat of the sun more than makes up for the slightly lower air temperature. Hence, for vegetation, the only alternation of season is from the dry to the wet season.

Sandal is a decided evergreen, and always shows its best growth in situations where the climate is most equable, or where there is a moderate supply of sub-soil moisture throughout the year. These conditions are found in Western Mysore, in the hills of Central Mysore, and everywhere in irrigated or watered gardens where there is moderate shade and moisture. Briefly, it may be stated, that Sandal requires an equable climate, with a rainfall of about 40 inches, and a mean temperature of about 74°, also, probably, some elevation and the full actinic force of a tropical sun.

Soil.—Sandal will grow on any soil, except the most tenacious and undrained, where in fact almost any tree would fail. The finest specimen of a Sandal tree I have ever seen felled, was growing on a sandy bank, by the side of a river, in the western Sandal country. Sandal occurs rarely, and then only when there is sub-soil moisture and drainage, along the banks of the Kabani and other streams which traverse the teak zone of south-west Mysore. There the soil is a stiff vegetable clay, very like what is known as black cotton soil. Sandal again may be often observed growing on the dams of tanks made of a similar tenacious black clay taken from the tank bed. But Sandal delights in a mixed loose soil, such as that which has crumbled down from old forts, and such as occurs in the sites of decayed towns, as at Halébíd and other places. There are no soils in Mysore which contain more than a small proportion of lime, but it is probable, from the fact that Sandal grows on all open soils in Mysore, that it would not refuse to accommodate itself to a calcareous soil. Where there is sub-soil moisture or in a very equable climate, as on hill tops, Sandal will grow in shallow soils or amongst the clefts of granite rocks. Indeed it shows a far better growth in such positions than among the deep, rich, but dry, loams of the plain country. All the soils in Mysore show a large percentage of iron, and possibly iron may be necessary for the full development of the

characteristic scent of Sandal. And here it may be remarked that experience in no way bears out the assertion that the best scented specimens of Sandal are from the most sterile situations. Taking two billets of small size, one say from the gravelly scrub forests, and another from either the western Sandal zone or the central hill forests, the first would be richer in essential oil, because, to become the same size as the second, it would have to be much older. Also the scrub tree would be probably hollow and very knotty, and knots are always dark, full of heartwood deposit and of essential oil. Thus, weight for weight, the scrub tree might show more oil and fragrance, but taking equal ages the scrub tree would be of far less value than the larger sound tree grown under conditions of soil and climate more suited to Sandal. A few years ago I received a specimen of Sandal from the Nizam's Railway forests, the heartwood of which was quite devoid of scent. There is a great similarity of soils in Southern India, and it is probable that the absence of scent in the Nizam's specimen of Sandal is due solely to a difference of climate. I can recall Major van Someren having mentioned some years ago that he had seen Sandal flourishing in some gardens at Surat, but that the wood was scentless and worthless.* Sandal trees may be observed occasionally in gardens and hedges, all over the peninsula of Southern India. In South Canara it grows in some quantity, and of good scent, down to very nearly sea level. The artificial rearing of Sandal for planting has shown that humus, or decaying vegetable matter of some sort, is absolutely necessary to Sandal during the first year of its growth, while in the nursery beds. If planted out afterwards on the red loams and lateritic gravels, with scarcely a trace of vegetable soil, on which Casuarina grows so well, Sandal looks starved. And again it has been noticed that it is easier to plant Sandal amongst grown up Casuarina than on a bare soil, and in forest than in the open. There are some good specimens of artificially planted Sandal growing in the yard of the Sandal depôt at Hunsur on old tan pits. I have seen it stated that the Dutch in Java plant Lantana on barren coffee land, which the Lantana enriches by its property of rapidly forming humus. Lantana is one of the few trees or shrubs in the dry climate of Mysore, which form a vegetable deposit akin to humus, and nowhere is there a more striking natural reproduction of Sandal than in the Lantana hedges which are so common round the grounds of houses at Bangalore. In Coorg and Wynád the introduced Lantana has be-

* We can predicate the same for Sandal at Poona, where the tree grows vigorously, and even reproduces itself naturally in abundance in hedges and gardens on black cotton soil. In the Nimar District of the Central Provinces, Sandal has become all but sub-spontaneous in one locality in the hills south-west of the fort of Asirgarh, but, as far as we know, only the wood of the root is scented.—[ED.]

come a pestilent weed. Last year Mr. Dickinson, the Forest Officer in Coorg, obtained some good results from sowing Sandal amongst Lantana. All these facts point to the conclusion that a soil which contains humus or decaying vegetable matter is essential to the natural reproduction and good growth of Sandal.*

Again, the shade of Casuarina, and its carpet-like accumulation of stalks on the ground, destroy grass and are hurtful to most vegetation; but self-sown Sandal can be observed growing under Casuarina in gardens at Bangalore and abundantly (in a few places where the trees are old enough to have formed humus) in the Government Casuarina plantations to the east of Bangalore.

The most common soils in Mysore are loams varying in colour from a deep chocolate red to a neutral grey. Generally speaking, the deeper these loams are in colour the richer are they in iron and the other mineral food constituents of vegetation. The subjacent rock all over the country is gneiss, usually with the mica more or less replaced by hornblende. In the south the gneiss becomes porphyritic with embedded crystals of a pink felspar. Gneiss may be witnessed in all stages of disintegration; first, the gneiss with the felspar decomposing *in situ*, then crumbling schists, and—when these schists are washed down and deposited by alluvial action—rolling downs of ever-varying loams and long stretches of barren gravels. The hills are composed sometimes of immense masses of solid gneiss, at other times of boulders and granite pebbles of all sizes.

In the western Sandal zone, loams, black clays, schists and gravels occur; and Sandal flourishes wherever it is permitted by grazing and fires, but agriculture usually restricts Sandal to the inferior soils. In the central hill forests Sandal may be observed growing on almost bare granite, provided there be a little humus to cherish its seedling life, and in the valleys on broken stone and thinly spread soils washed down from above. Among the central hill forests, where the early rains are light and often uncertain, it may be imagined that the hygroscopicity of humus is a necessity for the reproduction of Sandal. In the scrub forests which sometimes flank the hills and sometimes form long stretches by themselves, Sandal accommodates itself to miserable soils of gravel and light grey loams; the sole virtue of these soils being that they are usually loose at the surface and sometimes deep. There Sandal is the only tree which is specifically valuable, and the treatment of the forest should be

* In the Banka Barda nursery, Bhaonargarh Reserve, Betul District, Central Provinces, Colonel Doveton, Conservator of Forests, found Sandal seedlings growing as a root-parasite on the wild date-palm (*Phœnix sylvestris*); and such seedlings were more vigorous than others rooted independently in the soil. It would be interesting to enquire whether the greater success of Sandal seedlings in hedges and amongst trees than out in the bare open is not to some extent due to the peculiar habit noticed by Colonel Doveton.—[ED.].

that of regular coppice-under-standard. These scrubs, carefully coppiced, yield good fuel, and the Sandal forms naturally better standards than most of the associated trees.

North and east of Bangalore there is a series of laterite hills. Among these and the derived soils where Casuarina grows so well, Sandal is extremely rare at present.

Locality—Elevation.—There is a specimen of Sandal now in the Bangalore Museum sent by me from amongst several found growing on the banks of the Cauvery, at an elevation of only 1,200 feet. The growth of these trees—thin and straggling, suggests at once that Sandal is here in a climate too hot for it, and that it is on the verge of its natural habitat. But, contrary to what I had supposed, the heartwood of these trees presented an ordinary appearance, and did not appear to be deficient in scent. Growing on the banks of the Cauvery these trees had the benefit of both a sandy open soil and of sub-soil moisture from the Cauvery which is never quite dry. 1,200 feet above the sea is the lowest elevation of any portion of Mysore territory. I have not observed Sandal in Mysore growing more than a few feet above 4,000 feet, but the localities above 4,000 feet in Mysore are so very few, that there is scarcely an opportunity of judging whether Sandal would not grow well at higher elevations. Natural grown Sandal is absent from the top of Nandidrúg, where both shade and moisture abound, the average elevation there being 4,700 feet. There are some fine specimens of Sandal growing on almost bare granite on the top of Dévaraiyadrúg at an elevation of 4,000 feet, Dévaraiyadrúg being the oldest fire protected forest in Mysore. The limits in Mysore within which the tree may be observed in perfect growth are between 2,000 and 3,300 feet for the plains, and 2,000 and 4,000 feet for the hills. I should consider that, except in very exposed situations, Sandal would grow up to 5,000 feet with probably some increase in the density and scent of the wood grown at this elevation.

Aspect.—In a country so near the equator there is little to notice under aspect, but a northern aspect would be slightly drier and warmer than a southern.

Gradient and Configuration.—As already mentioned, Sandal shows no preference with regard to gradient: in the central hill forests Sandal is found in the most precipitous localities, in the western Sandal zone on nearly flat plains.

Dimensions attainable.—The largest tree I have met with measured 8 feet in girth, and gave $1\frac{1}{8}$ tons of heartwood when cut down. This is the tree mentioned already as growing on the sandy bank of a river. This river was the Hemavati, and the tree occurred in about the centre of the western Sandal zone. Even larger trees than this are occasionally met with, but they are extremely rare. The finest specimens of Sandal come usually from the western Sandal zone, but even here specimens yielding heartwood above a foot in diameter are scarce. From

the central hill forests it is rare to get trees with heartwood over 10 inches in diameter, and from the scrubs over 6 inches in diameter.

As regards height, Sandal grown in the open, in hedgerows or over scrub is always a low tree, the average length of bole not being more than from 12 to 15 feet. There is little heartwood in the branches, as they divide rapidly to form the bushy head which characterizes Sandal. Associated with other trees Sandal runs up into long poles, and clean straight pieces of small timber 50 and 60 feet in length, a great contrast to its ordinary stunted looking growth in the open. As regards the total height of the ordinary tree grown in the open, 40 feet may be taken as the maximum, and 20 feet as the average. But in some scrub jungles the average total height is not above 12 feet.

IV. *Habit.*—Sandal may be often observed forking close to the ground. Trees from root shoots, such as those in the circle of suckers, which come up where a Sandal root has been stubbed out, are more liable to divide close to the ground than seedling trees. The average and maximum length of trunk have been given above; a few feet below these dimensions the tree divides into its usually regular rounded bushy crown. Sometimes where shade and moisture are very abundant, Sandal becomes long and sinuous, twining amongst other trees, and taking a form approaching that of a creeper with a thick stem. I have observed trees of this description amongst the Areca nut gardens of Western Mysore, and occasionally in natural forests. For a small tree with small leaves Sandal may be said to have a moderately dense foliage, but it does not throw a dense shade. Where Sandal occurs gregarious in small patches, the tree's own covert appears to be insufficient for its natural reproduction from seed. Between a Sandal tree grown isolated, and a Sandal tree associated with a dense shade-giver, such as Tamarind, there is such a striking difference in the appearance of the foliage, that an observer, at first sight, would hardly recognize the two as belonging to the same description of tree. The tree grown isolated, or mixed with light shade-givers, has a foliage which is scanty or nearly bare in the hot weather, in colour of a light green inclining to yellow. The tree associated with dense shade-givers, has a larger leaf, which is dark green in colour. In dry forests, from an eminence, the Sandal trees can be distinguished for miles around, the very light colour of the foliage of Sandal standing out clear from amongst all other leaf tints. In shaded situations the tint of Sandal attracts attention by its rich dark colour. With the dark tint the leaves are both larger and thicker. This remarkable difference in the appearance of the leafage of Sandal affords some ground for the belief that the tree with the darker foliage and more vigourous growth has joined its roots to those of neighbouring trees, and is flour-

ishing, as a root parasite, at their expense. Dr. Bidie, C.I.E., the Curator of the Madras Museum, was, I believe, the originator of this belief, which has been accepted in some quarters, and is mentioned by Mr. Grant Duff in the botanical notes of his first tour in India.* Root parasitism is a thing difficult to prove or to disprove. That it does occur in certain cases we have the positive assertion of Dr. Bidie that he has dug up Sandal roots and found them to connect with the roots of other trees. Again it is sufficient to cut a Sandal root in the soil at any point to cause it to immediately throw up vigourous suckers, and occasionally when a Sandal tree is cut and the stump stubbed out, such a mass of vigourous suckers are thrown up as to suggest the idea of root parasitism. We know that the roots of Larch do frequently grow together, and unite so thoroughly, that the stool of a cut tree will cicatrice over with new layers of wood. But that Sandal ever commences life as an epiphyte-like plants of the allied order of Loranthaceæ, appears to be a mistake. During the twelve years that the forests of Mysore were under the observation of British Forest officers, no single case of Sandal as an epiphyte was noticed. In Mysore Sandal is the most important forest tree, yielding $\frac{2}{10}$ths of the forest revenue, so that a fact of this sort could not have escaped observation.

V. *Degree of ability to bear shade.*—Sandal, as already remarked, shows the best growth when partially shaded and associated with trees such as Tamarind, which throw a dense shade. When quite young, Sandal will bear the dense shade under old Casuarina trees, a shade which kills grass and almost all ground herbage. I have noticed some good specimens of Sandal trees self-sown on coffee estates in Manzerabad (West Mysore), where the coffee is usually so shaded by tall forest trees that not above one-third the amount of direct sunlight reaches the soil. Self-sown seedlings of Sandal are never observed except in shaded and protected situations. Sandal nurseries *require* a shade of boughs as soon as the fine weather sets in, and when planted out, it is the practice to stick a few boughs round each plant for shade and shelter.

VI. *Persistence of leaves.*—Sandal under the best conditions of growth is uniformly an evergreen. In dry deciduous forests there is a short and partial fall of the leaf towards the end of the dry season.

VII. *Age of fertility.*—Sandal has fertile berries from an early age. I have observed fruit on planted trees when four years old.† Sandal flowers at the end of the hot weather or early

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* See foot note above.—[Ed.]

† We have observed the same at Poona.—[Ed.]

in the rains, and the fruit is ripe in a few months, usually by the close of the rains. In the Sandal nurseries it is the practice to commence sowing in the early part of the rains, with old seed, and if the tile-pots are not fully stocked by the end of the rains, to complete with new seed. Sandal seeds regularly every year, and there is never difficulty in obtaining a supply of the seed. If not gathered at the end of the rains, the fruit speedily falls to the ground and rots, the albumenous pea-like seed decaying with the fleshy portion of the drupe. Old seed swept from the ground rarely germinates well. A small portion of the fruit usually remains on the tree through the dry weather and into the next rains, when flowers and fruit may be seen together on the same tree.

To preserve the seed, it should be gathered or picked off the ground while the fruit is still fresh, spread out to dry, and kept in a dry place for use. Large earthen jars are used for this purpose in Mysore, and attention is of course necessary in the rains, to see that the dried drupe with its enclosed seed, does not become damp and mouldy. Sandal seed prepared in this way and kept for two years, has been used on the Mysore plantations with good result; the opinions of the plantation mistries differ on the question of whether new seed or old seed germinates the better. The first attempts to grow Sandal artificially, on a large scale, failed uniformly, a failure caused to a great extent by badly prepared seed.

VIII. *Facility of germination.*—As a rule Sandal seed does not germinate well, or regularly, as regards time. On an average, Sandal seed takes six weeks to 'come up,' and if in an open vegetable soil and properly supplied with moisture, it will continue coming up for several months afterwards. Ordinarily, in a well tended nursery, less than half the seed sown will germinate, and this failure becomes readily noticeable with Sandal on account of the seed not being small. For instance, it requires on an average a small handful of Sandal seed to produce a dozen plants or to stock two tile-pots. It has been found in practice that the best way to induce a fair germination of Sandal seed is to scatter the seed on the surface of the soil, or to cover it lightly, if the soil is of an open character, and then bury the seed beneath a layer, an inch thick, of leaves, grass, the sweepings of a Casuarina plantation or other vegetable detritus. Half decayed leaves, such as are found under old trees, are the best to employ, if they can be readily procured. If white ants appear in the layer of vegetable soil they may be neglected: they will somewhat hasten the disappearance of the vegetable layer, but they render a service in depositing thin layers of loose soil over the seeds which they do not appear to touch as long as the seeds are alive. The layer of vegetable soil under any circumstances, if properly watered, speedily decays, and has to be partially renewed once or twice in a month. For other delicate seeds I

have found a similar layer of vegetable detritus to be an excellent thing; it preserves the seed at an even warmth and moisture, and its decay supplies readily-assimilable mineral matter to the young seedlings.

IX. *Faculty of growing up from stool and from root-suckers.*—A Sandal tree, if cut a foot above the ground level, or even nearer the ground, gives usually no shoots from the stool in the dry climate of Mysore. But Mr. Cherry, who was for many years Deputy Conservator of Forests in South Canara, has informed me that in the moister, warmer, climate of that district, Sandal stumps left in the ground usually throw up shoots. And the same observation (I may mention here) holds good with regard to trees killed by burning. In the damper districts in the Madras Presidency, a Sandal tree killed by fire is stated to shoot again from the root. In Mysore, Sandal trees in the plantations whose stems have been killed by fire, have invariably died outright; and in forests where Sandal should grow naturally, it is always absent where the jungle fires are severe.

On the other hand, from sections of the root, wherever cut, Sandal sends up shoots with the greatest facility. It is a cardinal point, in the treatment of Sandal, to fell the tree when marketably mature, and to remove the root at once, thereby ensuring a ring of shoots from the smaller roots left in the ground after the root stump has been extracted. A curious circumstance has occurred in connection with this root-shooting property of Sandal: all planting in Mysore is done in large pits usually a yard cube. These pits are dug as labour offers, and left open till the first rains and till the nursery plants are ready to put in. When this pitting is done on soil where there may be already a few old Sandal trees, (say ten to the acre,) at least one-half of the pits will cut some of the long tracing roots of Sandal in the ground: and whenever a Sandal root is cut it sends up a shoot. I have seen a portion of a Sandal plantation where the pits contained as many Sandal suckers as legitimate nursery plants: and Sandal suckers may always be observed in abundance whenever pitting is done near old trees. These numerous suckers considerably add to the appearance of some of the Sandal plantations in Mysore. I have tried on two occasions to propagate Sandal by burying root cuttings; but the success of this experiment is prevented by another well marked property of Sandal which then comes into play, namely, that Sandal roots will under no circumstances stand rough treatment in removal.

(*To be continued*).

A TALK ABOUT TREES.

SINCE being invited, some ten days ago, by your Secretary, to attend this meeting, I have been travelling every day, and have had no opportunity for writing, or for making references. I will not therefore attempt to deliver an "address," and must simply attempt to give you, from the abundance of the subject, a familiar talk about trees.

When this country first became known to Europeans, the soil was everywhere, throughout this State, and in all the Atlantic States, and in Canada, covered with forests, until we reach the prairies of the West and the treeless regions of the North. These forests differed greatly in density, and in the kind and value of their timber.

Of course, had these settlers then known all that Europeans now know, or all that we shall hereafter know about forest management, a considerable part of this would have been cleared, in order to make room for agriculture. The parts selected for this purpose would have been the best portions for tillage,—the intervals along the valleys, and the arable portions of the hills and the plains. But the hill-tops and the broken mountain regions, too steep and stony for the plough, and too poor for pasturage, would have been spared. They would have left the forests in the ravines, upon slopes liable to erosion, and upon sands liable to drift. But without this knowledge as to the proper care of woodlands, and without a further thought than to destroy everything alike, and without reservation, except here and there a wood lot, the country throughout the whole settled portion has been cleared, so that there are now but few large tracts of forest remaining, and the valuable timber has, to a very large extent, been cleared off. Much was burned to get rid of it, without any profit, excepting sometimes from the ashes. Forest fires have been invited in to aid in the destruction, and much that was not absolutely wasted without any return has been extravagantly used in needless degree.

This wanton practice has at length begun to attract the serious attention of thoughtful men in every part of the country, and they are asking one another—What shall we do to be saved from the inconvenience and distress which the extreme depletion of these supplies must occasion?

The great seal of Maine bears the device of a white pine tree, and that of your State the figure of a ship upon the stocks. The first of these emblems fitly represented the grandest element of wealth that the State of Maine then possessed; but it has

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* "A Familiar Talk about Trees" Delivered in the Hall of the House of Representatives, Concord, at a Meeting of the New Hampshire Board of Agriculture, on the evening of June 13th, 1883. By Franklin B Hough, Forestry Agent, Department of Agriculture.

since disappeared from their commerce almost entirely, and in its place we find them using up their spruces and hard woods, which must in time become equally scarce. The ship on the stocks reminds us of a time when the white oak and the white pine supplied the materials for an industry which was once regarded as of commanding importance, and worthy of adoption as the symbol of a State.

I have recently visited Portsmouth, your only sea-port, and they told me that this business of ship-building has died out almost entirely as a private enterprise, and that excepting what is going on now and then at the navy-yard, there is scarcely anything left. At Bath, the principal ship-building point in Maine, where a considerable number of ships are still built every year, the amount of tonnage is far below the totals of former years. They get their white oak from Virginia and other Southern States; their yellow pine from Georgia; their white pine from Michigan; and some of their "juniper" (tamarack) knees from Canada. They are already getting ready to build iron ships at that place, wisely foreseeing in this, a time not remote, when these timber supplies which they are now using will become scarce.

It is true that coal for fuel and iron for naval and civil constructions have in late years largely taken the place of wood; and to this extent they have lessened the demand for wood as a fuel, and for the heavy timbers formerly used in ship-building and in city architecture. But on the other hand, new uses for wood, in various forms, are daily appearing, and among these is that for the making of paper-pulp, of which, already, since a comparatively recent period, a large amount is made; and of this we have as yet scarcely seen the beginning, although nearly forty establishments exist in the New England States alone. Upon the whole, we may say that the amount of wood consumed as a material is increasing every year, while the existing supplies are as rapidly becoming less. I think it need not be proved, for the fact is evident, that although we may, to a large extent, employ stone, slate, tile, brick, and the metals for many uses in which wood is now taken, we can scarcely conceive of a time when this material from the forests will not be in great and constant demand, or when it could ever be less needed than to-day.

Let us for a moment compare the conditions of this country and of Europe, and especially with respect to the titles to land, and notice some points of difference that vitally concern the prospects of our future forests and our timber supplies. With us, the lands in all the older States, and throughout the settled portions everywhere, belong to private owners. Neither the States, nor the general government, nor any county, city, or town, has any woodlands, nor any land upon which forests could be planted. To make a beginning of public forest management, it would be necessary to obtain the title, either by purchase,

gift, or some lapse of title. It is in the most extreme degree improbable that any public authority whatever will ever plant upon private lands, or that any law would be passed, or could be enforced, that should compel the planting of lands by their owners. What remains of our woodlands, as well as all of the land on which the forests once grew, being now held by private owners, it is these owners who must do the planting of the future; and they will clear their lands, or rear forests, as their self-interest leads them.

Now in Europe we find upon the continent very different conditions. The governments, the communes, or other local organizations, and the public establishments of various kinds, are owners of considerable tracts of forest land, and administrations have been organized to take care of these interests. To get qualified agents for this service they have established schools of forestry. I have visited the forest administrations of every country in Europe that has a system of this kind, and about twenty of these schools, of which there are about thirty. At these schools, young men who have passed their first studies, about equal to what is taught in our academies, are admitted upon examination, and are carefully taught from two to three years in the sciences and the practices that apply to the care of woodlands and the removal and first working of forest products. They are taught mathematics, as applied to surveying, the measurement of contents, estimates of the growth and quantity of timber, accounts, and the like; the natural sciences that have reference to trees, and to all animal or vegetable life that may effect their welfare. Chemistry, geology, meteorology, mechanics, and, in short, whatever branch of knowledge is useful to the forester, including so much of laws and jurisprudence as may be needed in the discharge of his official trusts. Many of these candidates for the forest service are the sons of foresters, and one of the most talented of the professors of forestry in Europe is the son and grandson of men equally eminent in their profession.

The students in these schools have provided for their use extensive collections of tools and implements, models, cabinets of natural history, laboratories, libraries, forest gardens and nurseries, and the like, and every week they make excursions with their professors to learn from actual observation whatever concerns their pursuits. Once in a year they make a long journey to see forests and operations in planting under other conditions, and of these journeys they keep a journal and write up an account. Finally, after passing examinations that show approved attainments, they become entitled to a place, at first under an experienced forester, and afterwards by themselves; and they may rise through the various grades of the service, as in our army and navy, with the right to retire on a pension when working days are over.

Among the foresters' duties in Europe are the protection of game and the adjustment of rights of common usage, as, for example, where the inhabitants of a commune or village have a right to fuel, or building materials, or pasturage, and the like, upon their common lands. With none of these affairs relating to hunting or common rights shall we in this country ever have concern. The rights of hunting belong absolutely to the owner of the land, and of rights of common usage we have none.

Now in all of these foreign systems we have nothing to learn from their codes or their jurisprudence ; but we have everything to learn from their methods of planting and management, and from the scientific researches that are being made abroad. We could not give employment to men who were so highly qualified in these special sciences ; we need a less extended but plain and practical course of instruction for a greater number ; in fact, more or less of the first principles throughout the whole of our educational system, even down to the primary schools.

Every graduating class in a college should, at least, have the opportunity of hearing a few practical lectures upon forestry, and in several of our colleges, as in Dartmouth, instruction is now given in the class-room. In schools of less degree, it would be a most profitable thing to inculcate correct ideas, if nothing more, as to the importance of our woodlands in the welfare of the country, and the necessity of preventing injuries and avoiding waste.

As we begin to feel the need, we find springing up here and there inquiries under authority of law relating to the wants and the duties of the future, as depending upon the maintenance of our forest supplies. You have a commission named for the purpose in New Hampshire ; they have one ir Vermont ; a little has been done in New York ; and through State and local societies, of one kind and another, our people are beginning to turn attention to this subject, and to realize its importance.

It is not alone the want of wood as a material for ship-building, and erections of every kind upon the land, for manufactories and uses of infinite variety and importance, and for fuel, that is reminding us of this duty. We find effects upon our climate, upon the flow of water in our rivers and streams, and upon our agricultural interests everywhere, which may be, directly or indirectly, traced to the destruction of our forests as a principal cause. Let us briefly notice these several incidental effects, and the manner in which they are produced.

In a wooded country the climate is more humid on account of the great amount of evaporation that is going on from the foliage. The soil is humid because sheltered from the winds and the sun, and the streams are not liable to sudden floods and to drought, because they issue from swamps, or are fed by perennial springs. Let us notice the effect of clearings upon these conditions.

In an open, treeless region, the soil being exposed will sooner dry up after a rain, and if it be clay, it will become hard, so that the rain when it falls will run off at once, instead of sinking into the earth. The water, no longer obstructed by roots and rubbish, does not find its way slowly into the water-courses, but, upon steep mountain slopes and hill-sides, tends to wear ravines, which sometimes become immense chasms, and the rocks and rubbish carried down by the torrents cover the fertile valleys below with stones and gravel, and spread over the plains in destructive inundations that desolate the country far and wide. Finally, the sediment coming down to the sea forms sandbars at the mouths of the rivers, which cause lagoons and stagnant morasses that render a once healthy and fertile region a pestilential waste.

This picture is a faithful one of great regions in southern Europe, and especially in Italy and Spain. In other countries, as in Northern Africa, in Greece, and in Western Asia, we find vast solitudes and sandy wastes, now given up to hopeless sterility, which were once well cultivated by a dense population, and abounding in trees and fruits. We find everywhere in our own country that our springs and wells fail in summer, and that mill-streams once furnishing hydraulic power through the year are almost dry for months together. Rivers once navigable are so no more, and streams depended upon for feeding the reservoirs of our city water-works fail. The snows, prevented from drifting in a wooded country, accumulate in drifts behind fences or fill in the ravines, leaving our fields exposed to frost, and our winter grains to great injury and loss. The insectivorous birds are driven away because they find no shelter, and our fruits fail where they were once as sure as the returning seasons.

Now these facts cannot be denied, and they lead us to the all-important question—What shall be done to prevent further injuries, and to restore the conditions that we have lost?

The first thing to be done is to economize—to use less, and waste less. We have coal, and peat, and iron. We can use these, and stone, slate, brick, and tiles, in a great number of places where we now use wood. We can use up the waste products that are now allowed to decay. We can get tanning materials, when our hemlock is exhausted, by planting oaks. We can provide for future wants by re-clothing our broken lands everywhere with woodlands, and we shall begin to get the benefits, so far as they concern the climate, as soon as the ground is well shaded, although we may have to wait longer for the material that these woodlands should supply.

In travelling through your State—and it is much the same throughout New England and the Northern States generally—I have had frequent occasion to admire the facility with which an abandoned field will lapse again into a forest. You have none of the difficulties that they encounter as we approach the

arid regions of the West in making trees grow. They will grow themselves, and everywhere, if only allowed to remain where they find themselves a chance. But we should bear in mind that some kinds of timber are worth a great deal more than others; that it takes a long time for any trees to become of size suitable for lumber, and that almost always those of least value are of most rapid growth, thus shading out and killing off the more valuable kinds.

Of native species, you have various kinds of oak, ash, elm, birch, maple, linden, beech, chestnut, and others of the deciduous class; and of the evergreens, the pines, spruces, cedars, and the hemlock. It is an easy matter to determine from what has been which of these will thrive to advantage, and it is not worth while to experiment much on uncertainties. We need not try to prove, for this has been done by nature, that the chestnut will not grow on a limestone soil; that pines prefer a sandy soil, if underlaid by a subsoil congenial to their growth; that the maples and the beech avoid the sand and seek calcareous soils; and so on through the whole list.

But besides these native trees, we have within our range of opportunity many not native that will still thrive exceedingly well, some of them bearing seed and propagating their kind as vigorously as in their native home, and others that will grow well enough if helped to a place, but that do not reproduce readily from seed. In Scotland the larch, a native of Tyrol, has been found much more profitable than any of their indigenous trees. The elm in England thrives exceedingly, although its seeds are seldom fertile, and the most precious tree for planting in the North-Western prairie States in some situations is the white willow, which grows best from cuttings or sprouts.

Of trees not native I would suggest the black walnut, hardy catalpa, European larch, Scotch and Austrian pines, and certain of the European willows and alder as well worthy of experiment. They may prove perfectly well adapted to your soil and climate, and some of them, as for example the willows and the alder, a great deal more profitable than our native species. They will at least prove interesting as affording means for comparison and for botanical study, and add new resources to our list, already large, of trees suited for ornamental plantation in our villages and around our homes.

While speaking of exotic trees, it may be remarked that the conifers of the Pacific coast, which thrive so luxuriantly in their native region, almost uniformly fail in the Atlantic States, while the trees of Eastern Asia, the Himalaya region, and Japan, almost uniformly succeed. As these all differ in species, and many of them in genus, from those nearest like them in our own country, we have in these a precious opportunity for increasing an interest in ornamental plantations, and perhaps of adding to our list of exceptionally profitable timber trees.

Let us now come to consider a very practical question, which, at the beginning of your legislative session, may be deemed opportune, namely—How can a State encourage the preservation and restoration of its forests? It is true that individual enterprise, under the stimulus of high prices and the pressure of want, might find it profitable to seek these prices and relieve this want; but our land-owners, upon whom we must depend for future planting, will not begin to do this in a very extensive way until they feel this necessity upon them. It is not wise to wait till these evils are present. It is the part of prudence and foresight to provide seasonably for this future; and in this the State may render important services to its citizens in various ways short of paying for the expenses of planting, and among these the following:—

1. It may exempt waste and vacant lands from taxation for a limited period, where they are successfully replanted and protected for forest growth; or if there be a constitutional provision forbidding the exemption of private property from taxation, as in some of the States, it can declare that the increased value of lands by reason of forest growth shall not be taxed until some revenue begins to accrue.
2. It can stimulate rivalry by the offering of premiums for the greatest amount planted, the best management, or the most approved results in the introduction of exotic species, with reports showing the methods of operation, and other information best calculated for rendering this experience useful to others.
3. It can in like manner reward the authors of essays upon forest culture, and various subjects relating to the maintenance and management of groves and woodlands. To render these most widely useful, they should be printed for distribution among those engaged in planting.
4. It can provide for the establishment of experimental stations for the careful study of methods and the determination of facts of practical utility; and it can aid in this by the distribution of seeds and plants among those willing to co-operate in these observations.
5. It can provide for instruction in the first principles of forestry in the public schools, and to a greater degree in the higher institutions of learning in the State; and in a more general way it can enable agricultural, horticultural, and other societies to extend their operations in the discussion of subjects relating to forestry until special societies for this purpose are established.
6. In can provide laws for the prevention and control of forest fires, under which greater care would be taken in

the use of fires in or near a woodland, and a more direct responsibility attached to this act.

7. In some of the States where this has not been done, the State can enact laws compelling the owners of cattle to keep them within their own premises, thus removing one of the motives for setting forest fires, and tending to the welfare of the woodlands generally.

It is very generally observed that in a new country, and in the absence of an owner or his agent, the rights of property in timber are often disregarded, and it has been appropriated for use without much care or inquiry as to who the owner was. This is especially true with respect to timber upon the public domain, and upon railroad grants. But where groves are planted upon the lands of a resident owner or manager, there would be no greater liability to trespass than in a corn-field or an orchard. As a country becomes older, these private rights become better established. The hardy and sometimes lawless pioneer moves on with the advancing tide of civilization, and personal rights become better defined.

I might say much more that the opportunity allows concerning the amenities of life that are secured in home adornment, village improvement, and city parks, which are so many forms of planting and cultivation, in which the benefits appear in the public health and in the intellectual refinement and personal enjoyment which they secure to all who come within their influences.

We are accused by Europeans of being an unstable and restless people, having no strong attachments to ancestral possessions, and ever seeking new fields of enterprise in an uneasy desire for change. There is nothing that can more strengthen this attachment to home and country than by making them pleasant. It is only those who feel this attachment, that build monuments and that found institutions that will survive them as witnesses of their substantial interest in the welfare of the country in which they have lived.

I have faith in the Yankee! I believe in him! If you can only tell him where there is a dollar to be made or saved, *and make him believe it*, he will find the means to secure it. Now one of the ways of doing this is to plant trees. When planted, protect them. Teach the importance of this, and the methods by which it can be done to most profit, in your schools and colleges, and especially let every owner of land seek to advance this object, both by precept and example, and it will not be long before we shall begin to realize the advantages that should result from this measure.

SILK CULTIVATION IN THE PUNJAB.

It appears from the reports submitted to the Punjab Government during preparation for the Calcutta Exhibition that in that Province the Native silk industry is declining. The unadulterated silks of Native looms are gradually giving place to mixed silk and cotton goods imported from England and other European countries. These mixed fabrics of many colors and of gaudy hues find much favour with the unæsthetic Native who cares little for wear-resisting qualities of silk. Sericulture is practised but rarely among Natives, the silk used in the looms being imported in a raw state from Bokhara, Ladakh and Bombay. From the imported silk, articles of great variety are made, including turbans (which are greatly in demand), purses, waistbands, *phúlkáris*, and the brightly embroidered table covers, cushions and such like, which the mendacious Kashmiri pedlars have made so well known to Europeans. While, however, the Native silk industry is declining, the European silk cultivation carried on by the firm of Lister and Company in the Punjab at Gurdaspur, and in the North-West Provinces at Dehra Dún, appears to be in a flourishing state. Four varieties of silkworm have been domesticated, the Kashmiri, the Chinese, the Japanese, and the Assamese. The Kashmir and Japan varieties are the best suited to the climate of Upper India, the eggs being univoltine, *i. e.*, hatching under ordinary conditions only once in the year. The time of hatching is the spring, when the mulberry tree throws forth its new leaves, and the worms can only be reared so long as a plentiful supply of juicy leaves is forthcoming. In the plains it generally happens that the heat of the weather causes the eggs to hatch before the mulberry leaves have appeared; and as no other leaf provides suitable food, an insuperable obstacle arises to the general cultivation of the Kashmiri or Japanese worm. The Chinese variety of silkworm is bivoltine, the second hatching taking place almost immediately after the worms of the first hatching have spun their cocoons, and at a time when a supply of succulent leaves is almost unattainable. The second hatching is consequently useless, and the productive powers of the worm are wasted. The Assam silkworm is multivoltine, and has the further peculiarity of feeding on the leaves of the castor oil plant. It has not yet been domesticated in the Punjab, but has recently been reared on a small scale with much success at Dehra Dún under the careful management of Captain J. Murray. Cottage cultivation of silk has been abandoned by Lister and Company as a decided failure, and under present arrangements the agents of the firm carry on personally the whole process from hatching the eggs to reeling the cocoons.

PRACTICAL ENSILAGE.

In August 1883 a silo was constructed in the Allahabad Fort, under the orders of Major General Sir H. Macpherson. A subterranean chamber, used in ancient times as a dungeon, was selected for the purpose, and into it was thrown a large quantity of rank grass, the first growth of the monsoon. The predominating varieties were *Andropogon Bladi* (janéwar) and *Pennesitum cenchroides* (angan), both well known as excellent fodder grasses. The grass was cut, not scraped up, and much of it was thrown dripping wet into the silo. When enough had been filled in, a layer of white *bhúsa* was spread over the top to the thickness of about an inch. Over the *bhúsa* were laid a number of old railway sleepers, and over the sleepers were piled some 28 tons of round shot. The average weight was about 280 lbs. per superficial foot. No attempt was made to compress the grass before laying on the weights ; and no salt was added, as most authorities insist should be done. The silo was opened after a period of nearly six months. The upper layer of grass had solidified, and could only with great difficulty be cut open. The ensilage came away in sheets or layers. Its general colour was a greenish yellow, and much was very moist, and a strong vinous and acid smell was perceived. During the six months the grass had sunk to about half its original depth. The ensilage was issued as fodder for the siege train bullocks, 20 lbs. being given to each animal daily. Captain Wingate, who describes the experiment, says that the bullocks ate the ensilage readily. Mules and horses looked upon it with some suspicion ; goats refused to eat it ; but cows and calves fed upon it eagerly. The experiment may be said on the whole to have been most valuable, showing clearly that it is possible with great profit to store for future use the rank vegetation of the rains. The market value of ensilage is stated to be about 12 annas a maund.

JJ. Reviews.

FOREST ADMINISTRATION REPORT FOR BENGAL 1882-83.

In the review of this Report by the Government of India, it is said that it gives 'an exceedingly well arranged and clear account of the work done,' and this is just what occurred to ourselves in reading a report which is one of the first to mark a great advance in scientific working. Few Forest officers who read the account given in Chapter II. will fail to recognize this, and to feel interested in the account given of the results of the preliminary working schemes and plans of operations. Most noticeable is the comparison of the results of the working of the Rajabhatkhawa block in the Buxa forests as compared with the estimates originally made and based on valuation surveys. The results were that while 47,581 trees were expected to be cut between 1875-76 and 1882-83, the number actually found was only 16,582, *i.e.*, 35 per cent. The results of the valuation surveys could not, however, be expected to come very true, for they took no account of hollow and unsound trees, and besides we believe they were taken for the whole forest, and the average only applied to the block first worked, but which we understand is by no means the richest or best stocked. Now, it is presumed, will come the revision of the scheme, and perhaps next year we shall see compared with each other figures which are more nearly equal.

The table in para. 81 giving the results of the workings in the Kurseong Division will well repay examination; it is clear that the demand in some of the forests is equal to the supply, and that before long more detailed working schemes may be expected.

Next to the extension of the system of plans of operation, the most important points to be noticed of the year's working are those connected with the restoration to the Department of the forests of the Sonthal Pergunnahs, and the arrangements in progress for the introduction of forest conservancy in the private forests of Chota Nagpore, a work which is owing to the interest in the matter taken by the Commissioner Mr. J. F. K. Howitt. We quote the description of the forests of the Sonthal Pergunnahs, as it may be interesting to our readers—

"The reserved forest in the Dumka sub-division is described as occupying the hills of the Damin-i-Koh from the Bansloi river southwards

nearly to the Brahmini. It is a strip of irregular size—broad to the north, then narrowing, and again widening out. The vegetation shows, as plainly as can be, the effects of protection. The hill sides present a good growth of poles of various ages, but, as in most forests where *jhum* cultivation has formerly been practised, many of them are merely shoots from stumps, some 2 to 3 feet high, and consequently will, even if they grow to be large trees, always be unsound at the base. On the plateau the growth is not always so good, but thickets of small trees are met with and stretches of long grass, very liable to be burnt over. The area of the reserve is about 43 square miles, and it is demarcated in a very rough way by small heaps of stones round trees, but with no line cut from mark to mark; and the boundary line is a very tortuous one, and likely to be very troublesome and expensive if not altered, so as to give a better chance of its being useful for protection.

"In respect to vegetation and forest growth Mr. Gamble reports that the forests of the Sonthal Pergunnahs closely resemble those of the northern parts of Chota Nagpore, especially Hazaribagh. The chief tree is sál, and its distribution is universal, though, as elsewhere, it chiefly occupies the level ground at the foot of the hill slopes. Where there has been much jhum cultivation it has almost disappeared. The chief species which appear to come up on the abandonment of a '*kurow*' are the usual *Croton oblongifolius* and *Holarrhena*. On old hill '*kurows*' bamboo frequently comes up in great abundance, and seedlings of *Pterocarpus Marsupium* and *Ougeinia dalbergioides* are not uncommon.

"In the plains and valleys the sál is usually nearly pure, the chief accompanying species being *Buchanania latifolia*, *Semecarpus Anacardium*, and *Terminalia tomentosa*. On the lower slopes of the hills other species appear in considerable variety; among them are *Zizyphus xylopyra*, *Anogeissus latifolia*, *Diospyros*, *Cassearia*, *Stereospermum*, and *Bauhinia*. As the hills are ascended other species are met with, such as bamboos, *Pterocarpus Marsupium*, *Dalbergia latifolia*, *Gmelina arborea*, *Kydia calycina*, and *Grewia tiliæfolia*, the proportion of sál gradually getting less and less till on the upper plateaux it almost disappears, and on old '*kurow*' land gives place to a dense growth of shrubby trees, chief among which are *Nyctanthes Arbortristis*, *Wendlandia*, *Gardenia*, *Flacourtia*, *Woodfordia*, and *Anogeissus*. On the higher slopes above the first plateau sál again occurs, and of fairly good growth, and of this there is a fine example at Mahuagarhi.

"It is a noticeable feature that Salai (*Boswellia thurifera*), Galgal (*Cochlospermum Gossypium*), and the *Sterculias* are rare, even on the upper parts of the hills. The only locality where the two former were found in any abundance was in the north-western hills about Simra, where the climate is hotter and drier than further south.

"In the valleys of the northern faces of the hills some of the species which like moisture are met with, and noticeably *Bursera serrata*, *Vitex leucoxylon*, and *Ardisia humilis*, with *Ficus glomerata* and *Cunia*. There is no very great difference in the forest species composing the growth in the Dami-i-Koh, except that in the south, where the forest has been protected and outside cattle excluded, and where the climate is damper, the number of species is greater and the growth better; while towards the north, where there has been little protec-

tion, the grazing is extremely heavy and destructive, and the climate drier, the growth is checked and has become stunted and shrubby.

"The areas of forest, other than the reserve, which are also under general management, in so far that sál and one or two other trees are not allowed to be cut, are open to grazing and are regularly burnt over during the dry season.

"South of the Banslo river, however, a most admirable order has been some time in force, which allows grazing only to the cattle belonging to the villages in the district (Damin-i-Koh), while the entry of herds from other districts is prohibited. The result is most marked, for in the Dumka forests the growth is comparatively good, and the soil kept fairly well covered; while north of the Bansloi, and more so as we advance further and further north, the ground under the trees is usually bare, and is so worked up by the denudation of all ground vegetation and the conversion by trampling of the soil into dust, that the surface soil is either blown away by the high winds of the hot season, or washed away by the rains of the monsoon. Many patches of sál forest may be seen where the soil has been so denuded that each individual tree either stands by itself on a small hillock, or has its roots laid bare for some foot or two below the usual point. It is therefore recommended that the order about the grazing of other cattle than those of the villages interested be extended to the whole area of the Damin forests."

The Sonthal forests, if ever they are induced to grow so as to produce large timber, should prove very valuable, as their position is so good. They lie in the loop formed by the two branches of the East Indian Railway and south of the great bend of the Ganges. So too should the forests of Parasnath and Gobindpur prove eventually valuable, since they lie between the Railway and the Grand Trunk Road, and it may be hoped that the Government will find means to acquire them either by purchase or on perpetual lease, so that they may remain permanent reserves for large timber. Some of the other forests of the Chota Nagpore Zemindaries are also likely to prove most valuable, when the great railway lines which have been projected are commenced and means are found of cheaply and easily transporting produce to the market. It will be most interesting to read in the report for 1883-84, what measures it is proposed to take in regard to these forests, and what system of working has been introduced in the large area of sál forest in the Singbhúm reserves.

The area of Forest Reserves in Bengal is now 4,322 square miles, and there are still areas to be added, which roughly speaking will probably raise that amount to about 6,000 square miles, an extent which may be roughly taken as the final reservation in Bengal. The chief additions yet to be made appear to be in Singbhúm and Orissa. The work done in the formation of blocks and compartments and in marking them off, seems to be noticeable, and we extract the following account of the method employed in the Kurseong Division for marking off the blocks and compartments on the ground.

"The list given in paragraph 111 of the report for 1881-82 of the new blocks represented at that time the areas selected and marked on the map only. During the year the boundaries of the blocks have, as far as possible, been marked out on the ground with cleared traces, and in each forest that comprises two or more blocks small boards painted white have been put up on sawn posts of sál, oak, or other good timber, with the block numbers in Roman figures engraved on them in black paint. Compartment boards prepared in the same way, but with Arabic numbers, have been placed in position in all existing compartments, and similar boards have been got ready for most of the compartments decided on in the working schemes. This is a most useful measure, as it enables the range officers and guards to keep their records more accurately, and indeed it is absolutely necessary where forests are to be worked on a detailed working scheme."

The results of fire protection were fairly good in all Divisions except Julpigori, where about one-third of the area which it was specially attempted to protect was burnt. The result for the year was that 9 per cent. on the total area attempted was burnt as against 7½ per cent. in 1881-82. The cost is said to be Rs. 19 per square mile against Rs. 27 in the previous year, a result attributed to experience. But we are inclined to think that besides that reason the result is due to some extent to the addition of a large area, 38,640 acres in Singbhúm, of forest, which cost only Rs. 74 to protect, and if this is deducted the results of the year will be Rs. 21 per square mile. The most noticeable event of the year was the complete success attained in Palamow, a success which is the more remarkable, as there are large areas of dry grass in many of the reserves which are liable to catch fire very quickly during the extreme dry weather of May. If the Palamow forests can be successfully protected for a few years, the growth of the sál will improve greatly, and the operation of protection become easier and easier yearly. And there can be no doubt of the value of good timber in that locality, for one if not two of the proposed railways will pass through Palamow. We are glad to see from the chapter on Natural Reproduction that nearly all officers are unanimous in considering that natural reproduction is the best system for the Darjeeling forests, and that planting is unnecessary except for special areas and blanks. It is perhaps too much to hope that in the Darjeeling forests the expensive plantation works (Rs. 53 per acre) will be entirely given up, but if this can be done to a great extent, and the oak forests worked like those in Europe under the system of natural regeneration, it will be a step in advance in practical forestry. Of course it is clear from the returns that the cost of planting is diminishing, probably due to the enlarged experience of several years, but still even Rs. 35 per acre is too high for regular reproduction.

The work of replanting blanks and forming boundary belts has for some years been going on well in the Buxa and Kúr-

seong Divisions, and is worth bringing to our reader's notice. In the former Division 750 acres have been thus filled up at a cost of Rs. 17 per acre. This cost is evidently being gradually reduced, for the year's work cost only about Rs. 10 per acre. This is a most important work, and we are glad to see that so much interest is taken in it. In Palamow bamboo planting is being tried, but as yet unsuccessfully. Some hints as to this work may be found in many late Central Provinces reports, and especially in an admirable article on the bamboo lately published in our pages. On the subject of line planting in Chittagong the Conservator writes as follows :—

"The system of planting in lines may now be considered to have been fairly established as more satisfactory in its results than the former practice of clearing away open spaces. The expenditure is considerably less than in former years, and the vacancies fewer, owing to the shade afforded to the young plants by the bamboos along the lines, which also serves to check the growth of jungle on the lines and reduces the cost of re-clearing them after they have been planted up."

Road making and bungalow building still continue as hitherto to be well attended to, and the account of the various works will be read with interest. We do not propose to examine the results of the sales of timber and produce, except to notice that although departmental works have had to be kept up in most Divisions, yet every attempt is being made to substitute sales from the forest, under such conditions as will ensure economy and a proper revenue to Government from its produce sold. But it is evident from paras. 351 and 354 of the Report which we reproduce, that much has still to be done in Darjeeling, and that very great economy will have to be exercised to prevent the hill forests being worked beyond their possible yield.

"The attempt made during the last few years to induce purchasers to take over dry timber lying in the forests by the cubic foot, at rates varying from two to six annas, according to the quality of the wood, instead of at fixed rates per tree or log, has worked very well, the result being that 12,880 cubic feet were disposed of in this way during the year, against 1,583 cubic feet in the former year; the revenue realized having been Rs. 2,802, against Rs. 313. This is a very important and satisfactory improvement in the working of these forests, the demand on which is likely to increase every year. Were it not for the sale of this timber, the result chiefly of windfalls, which are distributed all over the forests, there would undoubtedly be a far greater demand for standing trees than the forests could safely supply.

"It was proposed to localize the sales of trees for scantling to the compartments allotted to the year, in the same way as the cutting of fuel is localized, the sales being at the same time limited to the capabilities of the forests, and this of course ought to be enforced; but if this system were carried out for years together, it would often happen that no trees suitable for scantling could be obtained from the

compartments set apart for certain years' working, and serious inconvenience would result to Government departments and to the public. The demand is in excess of the capabilities of the forest within moderate distances of the station of Darjeeling and of the railway, and endeavours are being made to meet this excess by working the more distant forests, and those of the Teesta and Kurseong Divisions."

The financial results of the year show as follows :—

		Rs.
Receipts,	... ...	6,93,959
Charges,	... ...	3,82,184
	Surplus, ...	3,11,775

the results showing both the highest *gross* and the highest *net* revenue since the department was started. It is very noticeable that the Bengal forest revenue has steadily increased at the rate of over half lakh of rupees during the past ten years. It is perhaps too much to expect such a rate of increase to continue, still, when the Orissa and Chota Nagpore forests come into regular working it may be possible, and the Bengal forests prove one of the chief contributors to the forest revenue of India.

THE FOREST SURVEY REPORT, 1882-83.

DURING the year 1882-83 the Forest Survey operations extended over parts of Kumaun, Garhwál, Tehri Garhwál, Jaunsár and Berar. Only 75 square miles remained at the close of the year to be surveyed in Kumaun and Garhwál, so that the principal work will for some years to come be concentrated on the Melghat forests in Berar.

During the year 361 square miles of forest were plane-tabled on the scale of 4 inches to the mile against 265 in the previous year, whilst 85 square miles were triangulated. This favorable result is said to be due to an exceptionally healthy season.

Less progress has been made in publishing the maps, and only eight sheets of the Kumaun and Garhwál survey were issued during the year. The cost per square mile came to Rs. 94 against Rs. 104 in the preceding year ; this is a very moderate price to pay for the great advantage of having reliable maps of our principal forests, the standing crop in which is, in Northern India at any rate, frequently worth half a lakh of rupees per square mile. The Surveyor General speaks very highly of the efficiency and good management of the Forest Survey Branch, at present under Mr. Reynolds as Superintendent, during Major Bailey's absence on furlough, and refers to the valuable assistance of Mr. Hennessey of the Trigonometrical Survey, in whose office the maps were photo-zincographed, and who undertook a considerable amount of printing and other work.

As the forests in the different provinces come into full working, these excellent detailed maps become indispensable. Without them, detailed organization schemes, generally called Working Plans, could not be made in any precise manner; and their value when a network of export roads is to be laid out, or in case of boundary disputes, is incontestable. Regarding their quality, we have Mr. Brandis' opinion that they are better than any forest maps in Europe.

The work of the Forest Survey Branch in the North-Western Provinces has been closely followed by that of the Local Working Plans, the hill forests being sub-divided into blocks by the water partings, and the blocks into compartments or working units, and the state of the standing crop shown by different colors and shades on the maps. We may thus in time hope that the working of all the principal forests in India will be regulated by a full consideration of their inherent resources, and not depend as it does too much at present, on the calls for more revenue from the local authorities.

WELL CONSTRUCTION.*

An interesting paper on this subject has recently been issued by the North-Western Provinces Government giving a variety of useful and minute information on irrigation wells and their construction. The author of the paper is Captain Clibborn, B.S.C., who was deputed specially for the purpose by the Department of Agriculture and Commerce. It goes without saying that the question of well irrigation is one of vast importance in this country; and since the amount of water available for irrigation is the measure of all agricultural extension, special information on the subject is not only desirable but necessary. Four points were specially selected for enquiry, viz., the available supply of water, the available supply of labour, the cost of irrigation, and the area of land which can be irrigated by a pair of cattle or men.

The subsoil water supply in the area lying between the Ganges and the Gogra is apparently inexhaustible, and the water level is almost everywhere within a reasonable distance from the surface. The water-bearing stratum as a rule is sand, which is generally overlaid by a bed of clay, indurated sand, or kunkur. Of these the clay bed or *mota* is by far the most important factor in well construction. Where it occurs wells are always possible, and most Native cultivators can state accurately its position and depth. The *mota* is not universally found, being entirely absent from submontane localities, and

* The Construction of Wells for Irrigation in the North-West Provinces Roorkee, Thomason College Press, 1884.

in only a few villages is it found to be continuous. The wells known as spring wells are always built on the mota, the curb or lower ring being firmly imbedded in the clay stratum. When the mota is pierced, water rushes up in an abundant supply. Spring wells, resting on the mota and receiving their supply of water from beneath it, form by far the largest source of irrigation. The only other wells are those which receive their supply by the percolation of water through their sides. It has generally been supposed that the use of the mota is to act as an artesian basin; but the fact that the mota is not continuous, and that frequently a copious water supply can be drawn off from above it, makes the artesian theory untenable. Mr. Beresford, Executive Engineer, Irrigation Department, has advanced another theory which seems to give a true solution of the question. In new wells when the mota is first pierced a quantity of sand is forced up into the well along with the water; this discharge of sand soon ceases, and as the well does not sink, it follows that a hollow must be formed beneath the mota giving a surface large enough to discharge a supply according to the "head" given, *i. e.*, according to the difference of level between the water inside and outside the well. The mota thus acts as a platform to support the well over the hollow in the sand. If a well rests on sand alone, abstraction of water causes continuous abstraction of sand also, and the well sinks into the hollow, the water being unable to make its way through fine sand with sufficient velocity to make up for the quantity taken out. In very coarse sand or gravel through which water percolates quickly the case is different, and such wells are often worked with success; but for the ordinary cylinder well, the existence of the mota is a necessity. It may be noted too that but for the resistance offered by sand to the passage of water, irrigation from wells would be practically impossible, for the subsoil water would fall away to the lowest point, namely, the level between great rivers; and whereas at present the depth of water from the ground surface is least on the table-lands, this depth, were it not for the water-resisting powers of the sand, would become a maximum.

Percolation wells are used when the mota does not exist, or is at too great a depth; or when wells resting on the mota become injured; or when mota wells can only be built at a great expense. In constructing wells a great saving is effected in the cost of drawing water by working two lifts together on the same side; and it appears that a 4-lift well worked on this principle is about the best that can be made. A well of this kind 8½ feet in diameter, with water at about 30 feet below the ground surface will, if properly worked, irrigate 60 acres of crops in a year. It is very advantageous to build masonry channels to all good wells, the cost of constructing such channels being actually less than the cost of re-lifting the water

which without them runs to waste. Wells built by Government yield a profitable return upon outlay, if an average rate of Rs. 2 per acre of annual irrigation be imposed.

The cost of well irrigation varies greatly according to circumstances; but in any case a crop watered from a well bears over an unirrigated crop a cost made up of the following charges—(1), interest on capital sunk in making the well; (2), annual charges; (3), cost of lifting the water required. These matters are discussed in great detail by Captain Clibborn, and we must refer our readers to his pages for fuller information than can be transcribed here. In conclusion, he gives some remarks on the possibilities of extending well irrigation especially by Government aid, which are well worthy of attention. The rest of the book is devoted to illustrations, plans, and very elaborate tables giving minute details concerning well irrigation. There is also a note on the construction and progress of the Government wells in the Moradabad District.

III. Official Paper

REPORT ON LOCUSTS.

From D. Macdonald, Esq., M.D., *Secretary and Curator, Victoria and Albert Museum, Bombay. To the Acting Under Secretary to Government, Revenue Department.*

With reference to Government Resolution No. 6075, dated the 16th August, 1883, I have the honour to submit my report regarding the specimen locusts sent to me for examination.

Several causes have delayed this report. When the specimens were first submitted to me, they were newly hatched; and it required a microscopic examination to determine whether or not they belonged to the True Locust Family—the Acrydiidæ—and it was necessary to wait until the insects developed in order to determine the species to which they belonged. When I asked for full grown insects in order to compare them with the young, and also in order to identify them, it was too late in the season, as the old generation had died out. I received however one or two old and battered insects from Thána, and these were sufficient to enable me to identify the species as that of the *Acrydium peregrinum*. I have been also delayed by my attempt to discover some simple, easily recognised, markings which would be sufficiently distinctive to enable even the unscientific to determine whether insects, suspected to be locusts, were or were not real Migratory Locusts; and once having found such markings I have been desirous of finding out whether they were to be found all through the life of the insect from the time it emerges from the egg up to the time when the insect becomes mature. I have only now completed these observations, and have obtained insects in all the different stages of development. I have also experienced great difficulty in finding out the particular species to which some of the insects belong. I could obtain no assistance from books. Even in the Asiatic Society's Library I failed to get any books, or monographs, on Entomology, or at least such as dealt with the subject in such detail as to treat of the various species of the family Acrydiidæ. I applied both to the Madras and Calcutta Museums and failed to get any help. The Calcutta Museum authorities replied that there was one gentleman connected with the Museum who took charge of the Invertebrate Department, but that he was in England just now; and advised that the insects

should be sent to England. This seems the best thing to do; and I accordingly send herewith two insect boxes which could be sent to England. It must not be supposed that those sent include all the species of the family Acrydiidæ found in the Bombay Presidency. I have myself received several other kinds which, however, came to me in so injured or decayed a condition as to make it impossible to preserve them. I have also found one or two kinds, in other years, when looking for other insects; which have not been sent to me at all.

The only scientific work that could supply full and reliable information on locusts is the "Reports of the United States Entomological Commission," (two large volumes,) which Government should get as a work of reference.

The word "Locusts" has at different times and in different places been used in many senses; and one unfortunate thing about the name is the fact that there is a family called Locustidæ to which the ordinary locust does *not* belong. The true or Migratory Locust belongs to another family called the *Acrydiidæ*, which differs from the Locustidæ in having only three joints on the tarsus or "foot" instead of four; and in having the antennæ short and thick instead of long and thread-like. The term "Locust" is now generally associated with the idea of a very destructive insect. This in itself, however, is not sufficient to give definiteness to the word, for, used in that sense, it has been, in North America, applied to insects belonging to the Cicadidæ, and in England even to the Cockchafers! When however we associate with destructive propensities the attribute of *migration* we narrow the definition in such a way as to include only migratory species of the family Acrydiidæ. Further we find that this term is used differently in the new world as compared with its use in the old world. In Europe by a locust is meant an insect of large size, the smaller allied species being known as "grasshoppers." But in America the insect known as "the Rocky Mountain Locust" would in Europe be looked upon as a "grasshopper" rather than as a "Locust." And yet it is this same "Rocky Mountain Locust" which attracted so much attention in America as to make the United States Government appoint a Commission of scientific men, who, in their "Reports of the United States Entomological Commission (two large volumes), have accumulated a mass of important and interesting information not only on the Rocky Mountain Locust but also on the locusts found in other parts of the world.

The best known Migratory Locust is the *Pachytylus migratorius*. It is common nearly all over Europe, and has been the cause of the numerous recorded locust "plagues" or "scourges" in Europe. Eastern Europe is especially noted for the oft-recurring devastations caused by the attacks made by the *Pachytylus migratorius*. They appear in swarms so enormous as to be scarcely credible. The south of Russia, with its vast corn-

producing plains, seems to be specially liable to this scourge. Conjectures have been made as to the original home of this insect, and it is probable that it came originally from some of the barren tracts or steppes of Central Asia. This is, however, little more than conjecture. It is certain, however, that what is called "the area of permanent distribution" (by which is meant the area within which the insect is always to be found), extends "from the parallel of 40° north, of Portugal, rising to 48° in France and Switzerland, and passing, in Russia, as far north as 55°, thence continuing across the middle of Siberia, north of China, to Japan, thence south of the Fiji Islands, New Zealand and North Australia; thence again to Mauritius and all over Africa to Madeira." The distribution in the southern portion of this vast belt is however uncertain. Of course "the area of occasional distribution" is still more vast. Thus it is well known that England has on several occasions been visited by the *Pachytylus migratorius*, and also Scandinavia and Finland. The vastness of this area has not unfrequently given rise to errors in determining the species, for the tract above described traverses regions where one or two other species perfectly distinct from the *Pachytylus migratorius*, are found, either permanently, or as occasional visitors. For example, the species known as *Pachytylus cinerascens* is the most common of the locusts found in Britain. A French writer asserts that this species breeds regularly in Belgium, whereas the *Pachytylus migratorius* is an occasional visitor merely, and it has been confounded with the other species.

The *Acrydium peregrinum*, which has within the last year or two been swarming over a large part of the Bombay Presidency, is believed to be little more than an accidental visitor to Europe. It has been seen occasionally in the south of Spain, and in 1869 was found over a large part of England. The *Acrydium peregrinum* is larger than the *Pachytylus migratorius;* and its area of distribution is much less definite. But Africa and the tropical parts of Asia, especially India, are considered its permanent area of distribution. Its destructiveness is not less than that of the *Pachytylus migratorius*. The *Acrydium peregrinum* is believed to be the species found in vast swarms in the Atlantic, far from land; and it is believed to occur in the West Indies and in Central America.

The *Acrydium* of North America resembles the *Acrydium peregrinum* very closely, but is said not to be migratory, and therefore is not a true locust.

Another closely allied species *Acrydium parananse*, found in the Argentine Republic, is migratory.

Calaptemis italicus is a smaller insect than those named, and has a limited area of migration. Its ravages however are as great as those of the better known species. It is a Mediterranean species found most frequently on the European side of that Sea, and extending occasionally into Southern Russia.

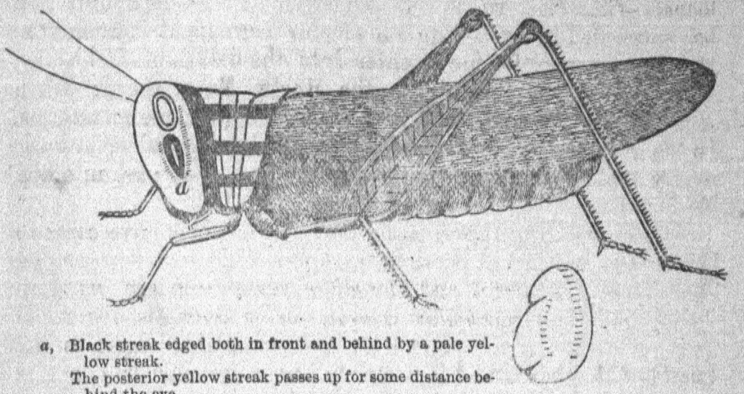
Calaptemis spretus is the "Rocky Mountain Locust" or "hateful grasshopper" of the North American Continent. Though a comparatively small insect, smaller than some grasshoppers of English fields, its destructiveness has procured for it, within the last twenty years, a notoriety equal to that of the locusts of the Eastern World. Recently its persistent migration has succeeded in extending its area of permanent distribution. It is unnecessary for me to enter into the details of its history, as it is confined entirely to the Rocky Mountains of North America, and the cultivated land which fringes these mountains. In its migrations, however, this insect has spread westwards nearly across the American Continent and even east into the Eastern States.

These constitute the most of the locusts which have come to be feared on account of their ravages. The two first named *Pachytylus migratorius* and *Acrydium peregrinum* are found in India, but the *Pachytylus migratorius* is only an occasional visitor. It has been found rarely on the Malabár Hills, in the Island of Bombay, and has probably been a traveller from across the sea. At any rate it is a comparatively rare insect in Western India. Not so the *Acrydium peregrinum*, which is indigenous to India. It is found on the slopes of the Western Ghâts—Mátherán and Mahábaleshvar, as well as less well-known hills—every hot weather. During the last few years, however, it has both increased in numbers, and has extended its area of migration; and the danger is that it may—as the Rocky Mountain Locust has done—gradually extend its "area of permanent distribution," which would then become a base of operations for a still wider "area of occasional distribution." It is to be hoped, however, that the recent extended energetic efforts of Government may stamp out, or at least greatly curtail, the scourge. It is difficult to account for the increase in the numbers of locusts, and also for the extension of their area. It is not impossible that the years 1878 and 1879, when there was deficient rainfall, may have been an indirect cause. As the vegetation on the hill-slopes was affected by the drought, the locusts may have extended their migrations into new regions in search of food. Their eggs were deposited in these new regions, and the young generations have continued the onward march commenced by the old, until now a large portion of the Bombay Presidency has been reached by the voracious insects.

This conjecture receives some colouring from the fact that, contrary to the usual custom by which locusts deposit their eggs in elevated barren tracts, the new generations have sprung up in cultivated and low-lying districts. One advantage of this new departure on the part of the locusts is that the District officers were able to detect the presence of locusts very soon after they had emerged from the eggs and when they could be very easily killed.

The distinctive mark by which, I think, it is easy for an intelligent person to distinguish true locusts even in the earliest stage of existence, is the dark streak which extends downwards

Rough Sketch showing Dark Streak in True Locust.



a, Black streak edged both in front and behind by a pale yellow streak.
The posterior yellow streak passes up for some distance behind the eye.

and backwards on the side of the head, beginning at the lower border of the eye. The dark streak is bordered behind and in front by a pale yellow streak, but the dark streak is sufficiently distinctive. In the young state, too, the true locusts are generally spotted, rows of dark spots running along the limbs and body. These are not found, however, in the adult state, but may serve to confirm the opinion formed from the presence of the streak on the side of the head.

Of the insects in the boxes sent herewith, those marked 1 are specimens of the true Migratory Locust—*Acrydium peregrinum*. The specimen with the coloured wings is one of last season's: the full-grown ones with the colourless wings are of the new generation. The skins are the final castings left behind when the locust emerges a full-grown insect. The spots on the limbs, &c., are still visible.

Those marked 2 are specimens of the insect which was found all over the Presidency early in the monsoon. I have already given a brief sketch of this insect, specimens of which were forwarded in bottles to England for identification, &c. I stated in my sketch that little damage was done by this insect. One District officer has recently affirmed that the insect is very injurious. The evidence, however, obtained from most districts is not in favour of this view; and I still think that the damage done by this species is insignificant, and would not be noticed in ordinary seasons.

The insect marked 3 is a single specimen of the *Tryxalis montana*. Specimens were forwarded to me from several districts, but in none of these was this species numerous enough to do any damage. The insect, however, is interesting, as Wood, in

his "Insects Abroad," avers that this insect was the cause of a moderate locust scourge in Sind, which was observed by Jerdon and another naturalist—a Civilian (C. Horne, Esq., F.L.S., late B.C.S.)—who wrote an account of it in Hardwicke's Science Gossip for 1871. I am inclined to think, however, that Wood's conjectures are erroneous, judging from the information I have received regarding this insect's life and habits as observed by some of the District officers.

Those marked 4 are specimens of a species found in Khándesh; but it may possibly be found in other districts. In Khándesh this kind was found only in sugarcane and swampy nálás, and was found to have done slight damage to the sugarcane.

No. 5 is a single specimen obtained from Khándesh where it was found in grass fields. It is common all over the Deccan and does no damage. It is easily distinguished by its large bright yellow and black underwings which are not shown in the specimen sent herewith, as the specimen came dried in the closed-wing position.

No. 6 consists of two, out of four specimens sent preserved in spirits in a bottle from the Ghâts above Thána, by the Commissioner, Mr. Sheppard. I took two insects out of the bottle and spread them out. These were the only specimens I obtained. I wrote for more specimens but failed to get any.

No. 7 is another of the Khándesh insects. It is found chiefly amongst grass, but is known occasionally to eat the leaves of Indian corn. It was found in only two tálukas.

I should like to mention here my indebtedness to Mr. Davidson, Assistant Collector, whose specimens were the only ones sent me that had been prepared in a scientific way. Mr. Davidson's detailed description of the living specimens was of much assistance.

BOMBAY,
10th December, 1883.

JY NOTES, QUERIES AND EXTRACTS.

JARRAH TIMBER.—As the subject of Jarrah timber is receiving prominent attention at the present time, and some valuable notes were supplied in our issue of February 23rd from Western Australia, it may not be out of place to supplement the same by a review of what was known by us of this wood in our home literature. Mr. Thomas Laslett, Timber Inspector to the Admiralty, in his valuable work "Timber and Timber Trees, Native and Foreign," says :—

"The Jarrah, or Mahogany Tree (*Eucalyptus marginata*), is found in Western Australia, where it is said to be very abundant. It is of straight growth and very large dimensions, but, unfortunately, is liable to early decay in the centre. The sound trees, however, yield solid and useful timber of from 20 to 40 feet in length, by 11 to 24 inches square, while those with faulty centres furnish only indifferent squares of smaller sizes, or pieces unequally sided, called flitches. The wood is red in colour, hard, heavy, close in texture, slightly wavy in grain, and with occasionally enough figure to give it value for ornamental purposes; it works up quite smoothly, and takes a good polish. Cabinet-makers may, therefore, readily employ it for furniture, but for architectural and other works, where great strength is needed, it should be used with caution, as the experiments prove it to be somewhat brittle in character.

"Some few years since, a small supply of this wood was sent to Woolwich Dockyard with the view to test its quality and fitness for employment in ship-building; but the sample did not turn out well, owing to the want of proper care in the selection of the wood in the Colony. The shipping officer sent only such small squares as might have been produced from logs cut or quartered longitudinally, which left in each case one weak or shaky angle, instead of sending the full-sized compact square log representing all that the growth of the tree would give. It is just possible, however, that this was unavoidable, since it may be inferred from the nature of the conversions that the trees from which they were cut commenced to decay at the centre at or about mid-life, and they had become hollow at the root-end of the stem long before they arrived at maturity. This remarkable defect being characteristic of the Jarrah tree, it follows that no compact and solid square log beyond the medium size can be obtained of the full growth, and hence the conversion of the faulty trees is necessarily restricted to the dimensions of flitches cut clear of the centre.

"One peculiarity was noticed in the sample referred to, some of the logs had cavities or blisters, varying from one to several inches in length in the longitudinal direction of the woody layers, and spreading from 1 to 3 inches concentrically, which occurred, like the cup-shake, at various distances from the pith, and at intervals of a few

feet along the line of the trunk of the tree. These cavities were partially filled with a hard secretion of resin or gum, which made up in some measure for the solidity, although it did not impart the strength which would compensate for the deficiency of the cohesive properties common to the annual layers *

"From what has been stated respecting the Jarrah timber received at Woolwich, it will readily be supposed that the authorities there did not look upon it with favour, or any desire to employ it for ship-building purposes. It therefore passed to some of the minor services of the yard, and it was while under conversion for these ordinary and inferior works that I took the opportunity of making the experiments which are given in detail in the following tables :—

Jarrah (Australia).—Transverse Experiments.

Number of the specimens.	Deflections. With the apparatus weighing 390 lbs	Deflections. After the weight was removed.	Deflections. At the crisis of breaking	Total weight required to break each piece.	Specific gravity.	Weight reduced to specific gravity 1,000.	Weight required to break one square inch.
	Inches	Inch.	Inches	Lbs.			Lbs
1	2 85	10	4 50	743	987	753	185 75
2	3 25	·15	4 50	638	1,049	608	159 50
3	3 25	·15	5 00	661	977	677	165 25
4	3·50	·15	5 00	661	1,039	636	165 25
5	3 15	·10	4 50	726	1,006	722	181·50
6	3 25	·15	4 75	685	1,002	684	171·25
Total, ..	19·25	·80	28 25	4,114	6,060	4,080	1028 50
Average,	3 21	·133	4 71	685 66	1,010	1,608	171 416

Remarks.—Each piece broke short.

Tensile Experiments.

Number of the specimen	Dimensions of each piece.	Specific gravity	Weight the piece broke with	Direct cohesion 1 square inch
	Inches		Lbs	Lbs
7	2 × 2 × 30	987	10,080	2,520
8		1,006	13,440	3,360
Total, ..	..	1,993	23,520	5,880
Average, ..	..	996	11,760	2,940

Vertical or Crushing Strain on Cubes of Two Inches.

No 9 Tons	No. 10 Tons	No 11. Tons.	No 12 Tons.	No 13 Tons.	No. 14 Tons	Total Tons	Average Tons.	Do. on 1 square inch.
12 875	13 000	12 625	12·750	12 750	12 750	76 75	12·792	5 198

* This peculiar defect is met with in several of the Eucalyptus species, and may occasionally be seen in the firs and pines.

"It is a noticeable fact, in connection with the experiments, that all the specimens tried proved deficient in strength and tenacity, by breaking off suddenly with a short fracture, under an average transverse strain of 686 lbs. weight only, or about 171·5 lbs. to the square inch of sectional area.

"Since the foregoing was prepared I have seen some correspondence between the Home and Colonial Governments on the subject of Jarrah timber, and also between the Governor of Western Australia and the leading ship-builders and ship-owners, including Lloyd's surveyor at Freemantle, who had been severally asked to report upon the merits of the Jarrah, with a view to getting it recognised at Lloyd's.

"Most of the ship-builders and ship-owners have reported very favourably, and speak of it as a good description of wood. They say that when used with iron fastenings neither material is in any way injured by the other, and also, what is a little remarkable, that it bends well without steaming. In speaking of its merits, however, they nearly all do so under some reserve, such as insisting on the felling being done at a certain time of the year, getting it from some particular district, and so forth. Lloyd's agent at Freemantle, however, does not report quite so favourably of it; indeed, he differs so widely from the rest, that perhaps it would be well to quote his report *in extenso*:—

"'In reply to your letter relative to the qualities of the Jarrah of this country as a ship-building timber, I consider it valuable wood for planking purposes as high as the wales, and I also consider it especially excellent wood for small craft which are not intended to be sheathed with metal, inasmuch as it resists the sea-worm better than almost any other wood, and is less liable to foul; but I do not consider it suitable timber for top sides or deck work, where it must necessarily be much exposed to the effects of the sun, it being, in such positions, more than ordinarily subject to shrink and warp, and it is rather deficient in tenacity of fibre, so that in situations where eccentric or sudden bends occur it cannot generally be employed with advantage. It is probable you may have heard of the Honourable East India Company's pilot brig *Salween* taking in a cargo of Jarrah at Bunbury. This was supplied by Mr. W. Pearce Clifton, and the vessel was sent at my instance, in order to a series of trials of the wood, in the Kidderpore dockyard. These trials, I regret to say, were not favourable to the character of the wood, and the result was that no further supply was ordered.

"'When last at Calcutta I obtained the sanction of the Government of Bengal to further tests of the wood, the greater portion of the *Salween's* cargo being then still in store, but I am sorry to say that the result was not more favourable than before.'"

"The Clerk of Works at Freemantle, reporting summarily upon the opinions expressed by the ship-builders and others, says:—

"'The sound timber resists the attack of the 'teredo navalis' and 'white ant.' On analysis by Professor Abel, it was found to contain a pungent acid that was destructive to life. The principle, however, was not found to be present in the unsound portions. Great care is therefore necessary in preparing the wood for use, by flitching the log so as to cut all the defective portions of the heart out, and using only the perfectly sound timber. Very much has been said about Jarrah

being subject to split when exported to India or England in log. It must be borne in mind that its density renders seasoning very slow, and that the inner portions of the larger trees are in a state of decay even while the outer portions are in full vigour. A tree under these conditions, the inner portions comparatively dry, and the outer full of sap, shipped at once to a hot climate like that of India, or to such a variable one as that of England, very naturally bursts from unequal shrinkage, being also exposed to very great changes of temperature. To obviate this peculiarity and apparent defect, let the Jarrah be felled when the sap is at the lowest ebb, and flitched as previously suggested.*

"'I have seen it stated in some correspondence from Western Australia that a specimen of Jarrah timber has been chemically examined by Professor Frankland, with the view to ascertain whether there is any peculiar acid or other substance present in it calculated to resist the attacks of 'teredo navalis.' It does not appear, however, that anything of the kind has been found which could be credited with the effect referred to. It is believed by the Professor that the singular immunity from attack which this wood enjoys is due either to the odour or taste it possesses. These, though by no means remarkable or repugnant to the human senses, are probably strongly so to the 'teredo navalis.'"

"From the foregoing statements it will be seen that there is great diversity of opinion upon the merits of Jarrah timber, and time only will show whether, if imported, it will find favour with ship-builders and others in this country.

"Some three or four years since (about 1871) the Western Australia Timber Company were busily engaged in the forests preparing a large quantity of Jarrah for exportation. The Company professes, I believe, to select only the best trees, and to cut them at the proper season; the deliveries should therefore be of the very best sort the country produces. I have earnestly looked for sample cargoes to arrive in the London docks, but up to the present (1875) none of any importance have been reported."

Our next author is Thomas Allen Britton, late Surveyor of the Metropolitan Board of Works, in his valuable work "A Treatise on the Origin, Progress, Prevention, and Cure of Dry Rot in Timber," who says :—

"The Jarrah wood of Western Australia is considered a first-class wood for ship-building, but it is somewhat slow to season, and if exposed before being seasoned is apt to 'fly' and cast. The methods adopted in seasoning are those of salt water, sea sand, and seaweed, of which the following are the details :—The logs are thrown into the sea and left there for a few weeks: they are then drawn up through the sand, and after being covered with seaweed a few inches deep, are left to lie on the beach, care being taken to prevent the sun getting at their ends. The logs are then left for many months to season.

* The Committee of Lloyd's have recently had the subject of Jarrah under their consideration, and determined to class this timber with those in line 3, Table A, of the Society's rules; thus ranking it with *Cuba sabicu*, pencil cedar, &c., for the construction and classification of ships.

When taken up they are cut into boards 7 inches wide, and stacked so as to admit of a free circulation of air round them for five or six months before using them.

A late Western Australian almanac says: "None of the neighbouring colonies possess timber of a similar character to the Jarrah, or endowed with equally valuable properties. If cut at the proper season, when the sap has expended itself and the tree is at rest, it will be found the most enduring of all woods. On this condition it defies decay; time, weather, water, the white ant, and the sea worm have no effect upon it. Specimens have been exhibited of portions of wood which had been nearly thirty years partly under water and partly out. Others had been used as posts, and for the same period buried in sand, where the white ant destroys in a few weeks every other kind of wood. For this peculiar property the Jarrah is now much sought after for railway sleepers and telegraph posts in India and the colonies. It is admirably adapted for dock gates, piles, and other purposes, and for keel pieces, keelsons, and other heavy timber in shipbuilding. Vessels of considerable burthen are built entirely of this wood, the peculiar properties of which render copper sheathing entirely unnecessary, although the sea-worm is most abundant in these waters."—*Timber Trades Journal.*

THE WOOD BUSINESS IN RUSSIA, ON THE TWO RIVERS DNIEPER AND BEREZINA.—To a stranger coming to Russia, who has seen wood business managed in other countries, the manner of going to work here certainly excites no small degree of surprise. One sees evidently it is the way that things were carried on in the time of our forefathers, and that new ideas have not found their way yet to this out-of-the-way part of the world, where every one seems to expose a shield against any new inventions, or any new improvements.

Still business is done here on no small scale; the mass of wood yearly floated down on these two rivers is something immense. From the moment, in the early spring, when the ice melts and the rivers rise some 10 or 16 feet above their usual level, one sees the rafts coming down in a succeeding mass.

Like all business in this part of Russia, the wood business is in the hands of the Jews. Owners of estates and forests sell part of their wood to them, and they know how to make the best of everything that comes into their hands. Winter begins here generally in November. In September, when the peasants have to pay their taxes, contracts are made up with them, when generally those who are living together in small villages agree, and bind themselves, against an advance, to cut and drive a certain quantity of wood down to the banks of the rivers. These advances are sometimes a third or one-half of the amount they can expect to earn during the course of the winter, but when signed by the elected members of the court of the village, or the Starosta and the Uradnisk as they are called here, one hardly ever risks anything by giving them advancement.

In November the peasants come to the woods, sometimes with one, sometimes with two, sometimes with three of their small pony-like horses, in the last case called troskas, collecting together often as many as 200 to 300 horses from one village. A sort of abode for the winter is then erected in the woods, built of small poles, earth, and straw, which reminds one more than anything of the huts of the Esquimaux and the Laplanders. The building is made in the following manner: earth is thrown up and made to a round flat cake, 1 foot high, and 12 feet to 15 feet in diameter. On this platform poles are placed so that it gets the form of a sugar-loaf. On the poles, which admit of a little hole in the top for the smoke to escape, is laid straw, and on the straw earth and sand; and on the side of this extraordinary arrangement there is an opening made in order to come in and out of this Russian mud-house. When ready 12 to 15 men make it their home for the winter. Furs, rags, and little boxes for provisions are placed all round, and the fire composed of large logs, and the large saucepan is in the middle. When the work of the day is over, and the workmen place themselves each on his place round the flaming fire, on which the soup, composed of meat, cabbage, and onions, boils, then is the time to see the Russian native, and hear his monotonous chant, reminding one of the inhabitants of some wild country. As for him, having no delicate nerves and his smelling organs seeming to enjoy the heavier and thicker the smoky air gets, he puts his rags round him, stretches himself out on the sandy ground, and, unmindful of storm or cold, sleeps the sleep of the innocent, till the morning light, which wakes him up, and reminds him it is time to put the primitive harness, generally made of rags and rope, on his poor half-starved horses, and go to his day's work again.

The cutting and driving is done in this way, and every peasant has his axe. He cuts down his tree, cleans it from knots and branches, lays it on his sledge, and drives it down to the river. So millions of trees come down to these two rivers in the course of the winter.

The sort of wood growing here is a sort of fir redwood, sometimes also whitewood. The fir tree grows here very fast. A fir tree which would want 120 years and more to get ripe in the north of Europe wants here only 80 years. It is, however, coarse, sometimes sappy, and contains a mass of resin and other glutinous matters, which makes the least knot of a bright red colour. To see the trees standing in the forest is a fine sight when they are straight, and grow high without branches, but cut them down and the charm is gone. Those masses of blocks, quantities of firewood, and birch, elm, alder, beech, and other kinds of wood, are being forwarded down the river during the entire spring and summer; most of it to the Black Sea, with the exception of a little part of it which is taken up against the

river to the Baltic. Most of the blocks are formed into large rafts. Holes are made in the end of each of them, and they are tied together with bands of willow. This is a clumsy and an expensive way of constructing rafts, besides cutting away two to three feet of each log. Two or three rafts are then tied together with willow bands, a little wooden hut is erected, sometimes hardly larger than a dog kennel, on which is a tiny pole with a bit of red or blue cloth as a flag. The three or four men who are in charge of this raft make this their home for the six or seven weeks, sometimes more, they are on their way to the Black Sea.

Another way of transporting different kinds of wood down the rivers is in the large lighters, sometimes called Berliner, sometimes Barkar. The former are very strongly built, but the latter are of enormous 60 to 80 feet long planks, large enough to load 200 to 300 standards, and only built for the one journey down to the Black Sea, where they are taken to pieces and sold. I had an opportunity of seeing both of these kinds of lighters built last winter. It was a queer sight to see three such Berliners building, each large enough to hold about 120 standards. There can be no doubt that in like manner the men-of-war must have been built some hundreds of years ago, when many battles were fought here between the Russians and the wild tribes from the east and south of Russia. The boards used were 5 to 6 inches thick, 15 to 20 inches wide, 50 to 60 feet long, hand-sawn out of one block of the finest trees found in the woods. Thousands of the most beautiful oaks were cut down and made into lighters, each in value equal to what one could buy a nice sized schooner for. Still more wonderful was the building of the barque, which was a sort of Noah's Ark as to size. How they got this enormous structure to hold together and keep tight is something I cannot understand, more especially as it was built to pass the cataracts between Kremenchuek and Cherson. Most of the timber is being sent down to Cherson, Nikolaieff, and Odessa, only some part of it is sold on the way at Kief and some other places. In Cherson are large saw mills, where a great many of the blocks are being transformed to deals and boards, another part of the blocks are being shipped from Nikolaieff and Odessa in the form of square timber.

There are some saw mills in this part of Russia also, but they are as old fashioned as everything else, where some thousands of blocks yearly are sawn to large boards, mostly all of one size, and sold at so much a piece at Kiew.

In this part of Russia there exists a decided feeling against foreigners, or one is nearer the truth in saying that the Russians hate strangers, and with the dim idea they have of what is right and what is wrong, they consider it their duty to persecute them as much as ever lies in their power. Cunning and intrigue seeming to form their character, they can no doubt do a great

deal of harm to any one coming down here who is unprepared, and not knowing what sort of people they are.

In the end of 1882 a wood-exporting firm in Finland made an agreement with a Count v. M., in St. Petersburg, who was the owner of a large estate with extensive forests in this neighbourhood, to take out the value of the woods for joint account. The forests contained about a million of trees, ripe for cutting, and these were to be made into money in as short a time as possible. Plans were made; a saw mill with six frames and a planing mill were to be built, and 80,000 trees were ordered to be felled the first year. The trees were felled, the saw mill was built, workmen were collected from Sweden, Finland, and Riga. Last summer the saw mill was so far ready that sawing began, when the firm in Finland unexpectedly came into difficulties. Money was not sent to pay the workmen. Some time after the firm in Finland was made bankrupt, and the owner left for America. The Count v. M. stopped payment in the real sense of the word, and there the poor workmen were left with their wives and children in utter want of money, in an exceedingly dangerous climate, where fever and illness came more regularly than the daily bread, without means to buy medicine and without a medical man to attend them. Death visited them through typhus, and they had to bury their dead themselves, the Roman Catholic clergymen asking an impossible price to read the service.

To tell of all the intrigues, all the unfulfilled promises, and the mean behaviour on the side of the Russians against these poor people would be of no use. Suffice it to say that by their common efforts they got over the first part of the winter, and now, through the help of the Swedish Ambassador and the Finnish authorities in St. Petersburg, they were sent home to their respective countries, penniless. The business is entirely wound up, and the very fine saw mill, with its first-rate machinery and every new improvement, is standing waiting for a new owner who may have sufficient means to make himself independent of Russian intrigues, and be able to continue a business which began so hopefully a little more than a year ago.

My intention, in referring to this business, is to warn strangers not to try their luck in Russia without being backed by people whom they thoroughly know and can have entire confidence in.—*Timber Trades Journal.*

Pruning Fruit Trees.—The principal use of pruning is to preserve the symmetry of the trees, though in closely planted orchards it is necessary to prune to keep the trees within bounds. Pruning for either of these reasons is easily accomplished, but there are other reasons for pruning which only the man of experience and scientific acquirements can properly understand.

Supposing an ordinary pruner was sent into an orchard to prune, his endeavour would be to carry out either or both of the above-named purposes, and he would therefore probably prune the hardest those trees that had made the most wood, and leave unpruned or lightly pruned those that had made little or no wood; while the man of experience would be likely to act in a directly opposite manner; he would be aware that the trees making the most growth were the least fruitful, while the others had probably borne more than they could bring to a first class condition. His object, therefore, would be to reduce the bearing propensity or power of the latter, and by the same means increase their power of growth; while in regard to the former he would endeavour to check their exuberant growth, and induce them to become more fruitful. The over-prolific trees he would prune hard, thinning out a large proportion of the fruit-bearing spurs, by which means the supply of sap the roots were able to send up the following spring would be less divided, and each remaining bud would receive a larger share than it would have done had the whole of the buds been allowed to remain and claim their share. The result would be that each bud, having received an extra supply of sap, would make stronger growth and more foliage than before; the leaves, by reacting upon the roots, would cause a great extension, and so the vigour of the tree would be increased; the enlarged number of roots sending up a constantly increasing supply, both shoots and fruit would benefit thereby. That such results would be obtained may be seen whenever a tree, whether aged, decrepit or young, is headed down; the superabundance of nourishment, finding a limited demand, becomes used up in the formation of wood of vastly increased strength, while any fruit there may happen to be is proportionately enlarged. In this climate the fruits of cooler countries are forced, as it were, by the, to them, unnatural amount of heat and light, into a condition of precocity, which, if not checked, must necessarily end in weakness; the endeavour should therefore be to counteract the tendency to precociousness and maintain the tree in a well balanced condition, producing no more fruit than it can bring to full maturity, and a due proportion of wood for the maintenance of that condition —a suitable and properly cultivated soil, with due supplies of manure, being, of course, understood. The difficulty of attaining the desired result is sometimes greater in the case of an over-luxuriant, and therefore partially or quite barren tree, than in the opposite case, especially when it happens to have an unlimited root run. Trees in such a condition not unfrequently continue to receive the usual amount of pruning year after year, thus producing such an exuberance of sap that blossom buds cannot be formed, except on a few weak and pinched spurs, and increase so slowly in number that it requires many years before the tree is brought into a full-bearing condition;

whereas, if such a tree is left altogether unpruned, it would certainly become fruitful either the next or the following year. The aim, then, should be to maintain a fair balance between the production of wood and fruit, and if the nature of the variety to be operated upon is known, a scientific pruner can soon establish, and afterwards maintain his trees in that condition, by checking over-luxuriance, and encouraging the formation of fruit buds, or the contrary, as may be necessary. Much good may, in many cases, be effected in checking over-luxuriance by summer pruning, for if the young growth of the most vigorous tree is continually stopped, its vigour will presently be reduced, and even its health may be impaired, if the process is carried to an extreme. Summer pruning is generally neglected, partly from ignorance of its good effects, and partly because orchardists have little leisure at that season. It is, however, of great value, especially in the formation of useless wood that has to be cut away at the end of the season, and increasing the strength of that which has to remain.—*Leader.*

TIMBERS FOR TEA BOXES.—One of the lightest woods we have is Simal (*Bombax*) or cotton tree, and I have known whole chests made of it weigh only 12 lbs., though the wood was half an inch thick. It is however liable to split if it receives hard knocks.

One of the best woods for boxes is Roghu, formerly Nauclea Kadamba or Kodom, *Anthocephalus Kadamba*,—called Kodom in Bengali, and Halamba in Sinhalese. When seasoned it is fairly light, strong, and tough. In Assam it generally has a tolerably straight, clean stem 30 to 40 feet long, which is continued up through the head or crown, the latter composed of a mass of *radial* branches.

As a rule the head of foliage is domed, and the lower branches have a tendency to droop and hang down all around. Roghu is one of the very few trees that generally carries its stem, of central axis, right through the crown to the very summit: and when young it is very symmetrical.

Externally the bark is dark brown or grey, and fissured by cracks longitudinally; inside it is a brown or dark dim color. When young, the bark is particularly clean and smooth, and of a pale grey green.

There is no heart, and the wood is yellowish white, soft and even in texture, easily cut, whether green or seasoned. The leaves are stiff, large and entire, pointed, and with short footstalk; on old trees they are from 8 to 10 inches long by 5 or 6 inches wide. They are much larger on young trees, and I have measured one 31 inches long by 20 inches wide, on a one-year old plant 10 feet high.

The flowers are small and clustered in a ball, 2 inches diameter, that ripens about October.

Roghu has several peculiarities worth recording; the growth is remarkably rapid for the first 6 or 8 years, becomes slower on to 20, and then is very slow. During the first 2 or 3 years it grows some 10 feet per annum in height, while the girth in same period is often an inch per month. I have cut 10 inch planks for boxes out of Roghu only 8 years old, and am now felling a good many that are 16 years old, and at 6 feet up, measure (an average of 5) to 5 feet 5 inches girth, while at 30 feet up they measure 3 feet 8 inches in girth. Up to 8 or 10 years old it grows so rapidly as to be worth planting, but after 15 or 20 years, is so slow that it is most profitable to fell when about 12 years old.

Another peculiar feature of this tree is the difficulty of propagating it from seed, while at the same time it springs up in millions naturally on new clearances. I once estimated that I weeded out 450,000 Roghu seedlings on 25 acres of clearance. Taken altogether this tree is one of our best for tea boxes, both on account of its natural qualities as a wood, and as a tree; and the pity seems that it is not more extensively grown by Planters and Government, especially as it takes such a short time to reach useful size. It is on this latter account I place it first *on the list of box* timbers.

In my last I drew attention to Roghu, or Kodom, formerly *Nauclea Kadamba*, as one of our best box timbers, also to Sotiana, Chutni, or *Alstonia scholaris*, and Pati honda, which is *Cinamomum obtusifolium*. I omitted to notice that the last is called obtusifolium perhaps in consequence of the way in which the points of the leaves are damaged.

I have frequently searched the foliage of a felled tree for an entire leaf, and generally failed to get even one perfect,—all seem eaten by some insect. It would be interesting to know if this peculiarity is local, or common.

Poma—*Cedrela Toona*, or the tún tree, before noted, is an excellent box-wood; it is both light and strong, though not very tough; unfortunately it is not a very common tree, and if used for boxes, the supply would likely run short. It is easily propagated, and grows rapidly, so that it is a good one to have in reserves. It is apt to split in felling, unless care is taken. Poma boxes weigh about from 20 to 25 lbs., and this is not the same wood that comes to us as "Cedar" from Burma: the latter is heavier, harder, and less attacked by white ants.—S. E. P.—*Indian Tea Gazette.*

V. Extracts from Official Gazettes.

1.—Gazette of India—

No. 229.—*The 10th April, 1884.*—*Mr. D. P. Copeland,* Officiating Assistant Conservator of Forests of the 3rd grade, in Assam, is confirmed in his appointment, with effect from the 11th March, 1884.

2.—Calcutta Gazette—

The 25th April, 1884.—*Mr. W. M. Green,* Officiating Deputy Conservator of Forests, Chittagong, is allowed privilege leave for three days, in extension of the leave granted to him under the order of the 15th January, 1884.

3.—North-Western Provinces Gazette—

No. $\frac{545}{\text{II-280}}$.—*The 5th April, 1884.*—With effect from the 16th December, 1883, the date on which *Mr. C. J. Ponsonby,* Officiating Deputy Conservator of Forests, 1st grade, was confirmed in that appointment—

Mr. W. G. Allan, Officiating Deputy Conservator of Forests, 2nd grade, to revert to his substantive appointment of Deputy Conservator, 3rd grade.

Mr. J. M. Braidwood, Officiating Deputy Conservator of Forests, 3rd grade, to revert to his substantive appointment of Deputy Conservator, 4th grade.

Mr. N. Hearle, Officiating Deputy Conservator of Forests, 4th grade, to revert to his substantive appointment of Assistant Conservator, 1st grade.

No. $\frac{760}{\text{II-314}}$.—*The 19th April, 1884.*—*Mr. N. Hearle,* Assistant Conservator of Forests, 1st grade, from the Oudh to the School Circle, and to be placed in charge of the Jaunsar Forest Division.

No. $\frac{761}{\text{II-314}}$.—*Mr. A. G. Hobart-Hampden,* Assistant Conservator of Forests, 3rd grade, from the Oudh to the School Circle, and to be attached to the Tons Forest Division.

4.—Punjab Gazette—

No. 162.—*The 28th March, 1884.*—With the sanction of the Government of India and of the Government of the North-Western Provinces and Oudh, *Mr. E. McA. Moir,* Deputy

Conservator of Forests in the North-Western Provinces, is appointed to be an Assistant to the Superintendent of the Simla Hill States in the Punjab.

No. 163.—Under the terms of the Bashahr Forest Lease, *Mr. E. McA. Moir*, Assistant to the Superintendent of the Simla Hill States in the Punjab, is invested with the powers of a Magistrate to try offences against the Rules of the Bashahr Forest Lease within the limits of the Bashahr territory.

No. 169.—*The 2nd April, 1884.—Mr. A. M. Reuther*, Assistant Conservator of Forests, returned to duty on the forenoon of the 17th March, 1884, from the privilege leave of absence of three months granted by Punjab Government Notification No. 9, dated 8th January, 1884, and took over charge of the Jhelum Division on the same day from *Mr. W. E. D'Arcy*, Deputy Conservator of Forests.

No. 178.—*The 8th April, 1884.—Mr. J L. Pigot*, Assistant Conservator of Forests, is transferred from the Lahore to the Bashahr Division. He left the former on the afternoon of the 18th March, 1884, and joined the latter on the forenoon of the 20th idem.

No. 181.—*Mr. W. Shakespear*, Deputy Conservator of Forests, is transferred from the Mooltan to the Rawalpindi Division. He made over charge of the former on the afternoon of the 11th March, 1884, and received charge of the latter on the afternoon of the 13th idem.

No. 182.—*Mr. E. S. Carr*, Assistant Conservator of Forests, is placed in charge of the Mooltan Division, with effect from the afternoon of the 11th March, 1884.

No. 183.—*Mr. C. F. Elliot*, Deputy Conservator of Forests, Rawalpindi Division, was relieved of his duties on the afternoon of the 13th March, 1884, and proceeded on leave subsidiary to the furlough granted to him by Punjab Government's Notification No. 82, dated 16th February, 1884.

No. 185.—His Honor the Lieutenant-Governor has been pleased to make the following temporary promotions, with effect from the 14th March, 1884, consequent on the departure on furlough of *Mr. C. F. Elliot*, Deputy Conservator, 3rd grade :—

Mr. E. Forrest, Deputy Conservator, 4th grade, to Deputy Conservator, 3rd grade.

Mr. A. M. Reuther, Assistant Conservator, 1st grade, to Deputy Conservator, 4th grade.

5.—CENTRAL PROVINCES GAZETTE—

No. 1632.—*The 3rd April, 1884.—Mr. R. H. C. Whittall*, Deputy Conservator of Forests, on special duty in the Chanda Division, is appointed to the charge of the Chanda Forest Division.

Mr. Whittall received charge of the same on the afternoon of the 10th March, 1884, from *Mr. J. Macpherson*, Deputy Conservator of Forests, retired.

No. 1937.—*Mr. H. B. Anthony*, Assistant Conservator of Forests, attached to the Bhandara District, assumed charge of the 2nd class reserved forests of that district, on the 5th instant.

6.—BRITISH BURMA GAZETTE—

Nil.

7.—ASSAM GAZETTE—

Nil.

8.—MYSORE GAZETTE—

Nil.

9.—MADRAS GAZETTE—

The 13th March, 1884.—*Mr. H. H. Ward*, Forest Ranger, Kódúr Range, is granted two months' extension in continuation of the three months' sick leave granted to him in office order No. 56 of 1883-84.

The 25th March, 1884.—The sick leave for three months granted in office order No 60 to the late *Mr. E. Dampier*, Sub-Assistant Conservator of Forests, Ganjam, is converted into privilege leave with effect from the 2nd February, 1884.

The 5th April, 1884.—Forest Ranger *A. S. Maria Pragásam Pillia* (on probation) is transferred from the Tinnevelly to the South Coimbatore Division, with effect from date of *Mr. Moss'* relief in the latter division.

10.—BOMBAY GAZETTE—

No. 2729.—*The 31st March, 1884.*—*Mr. C. Greatheed*, 1st grade Assistant Conservator of Forests, Sukkur Circle, is allowed furlough for eighteen months under Section 49 of the Civil Leave Code, 5th Edition, from the 1st May, 1884, or such subsequent date as he may be able to avail himself of it.

No. 2832.—*The 3rd April, 1884.*—*Mr. Lakshman Dáji Joshi*, Sub-Assistant Conservator of Forests, Khándesh, was allowed privilege leave of absence for one month and fifteen days from the 19th February, 1884.

No. 2922.—*The 7th April, 1884.*—*Mr. A. T. Shuttleworth*, Conservator of Forests, N. D., is allowed furlough for six months from the 18th instant, or from such subsequent date as he may avail himself of it.

Lieutenant-Colonel W. Peyton, Conservator of Forests, S. D., is appointed to act as 1st grade Conservator of Forests; *Lieutenant-Colonel J. G McRae*, Conservator of Forests in Sind, to act as 2nd grade Conservator, and Conservator of Forests, N. D.; and *Mr. W. S. Hexton*, 2nd grade Deputy Conservator of Forests in Sind, to act as 3rd grade Conservator, and Conservator of Forests in Sind, during the absence of *Mr. Shuttleworth*, or till further orders.

No. 2953.—His Excellency the Governor in Council is pleased to make the following appointments in the Forest Department —

Messrs. R. P. Ryan, G. M. Ryan and *Shoukrám Peribdás*, to be 3rd grade Sub-Assistant Conservators of Forests.

Messrs. W. G. Clabby and *G. F. Blackwell* to act as 3rd grade Sub-Assistant Conservators of Forests, Northern Division.

Order No.	Species.	Quantity.			Supplied during 1951-52.			Balance.			Remarks.
		Tons.	C.ft.	Amount.	Tons.	C.ft.	Value.	Tons.	C.ft.	Value.	
1	2	3	4	5	6	7	8	9	10	11	12
					Old orders.						
				Rs.			Rs.			Rs.	
1129 ..	Ballies	5	..	(b) 9,900	..	..	..	5	..	9,900	
					New orders.						
4773 ..	Ballies	72	46	7,000	9	25	910	63	21	6,090	
Total ..		77	46	16,900	9	25	910	68	21	15,990	

ABSTRACT.

	Old Orders.	New Orders.	Total.	Supplied.	Balance.	
Logs quantity ..	2,646 tons 11 c.ft.	41 tons 37 c.ft.	2,687 tons 48 c.ft.	1,166 tons 46 c.ft.	1,221 tons 2 c.ft. 300 tons 0 c.ft.	(a)
					1,521 tons 2 c.ft.	
Value ..	Rs.6,20,095	Rs.3,250	Rs.6,23,345	Rs.2,68,099	Rs.2,87,746 Rs. 67,500	(a)
					Rs.3,55,246	
Sawntimber ..	69 tons 38 c.ft.	489 tons 36 c.ft.	559 tons 24 c.ft.	282 tons 42 c.ft.	276 tons 32 c.ft.	
Value ..	Rs.22,023	Rs.1,76,580	Rs.1,98,603	Rs.98,860	Rs.99,743.	
Ballies ..	5 tons	72 tons 46 c.ft.	77 tons 46 c.ft.	9 tons 25 c.ft.	68 tons 21 c.ft. 5 tons 0 c.ft.	(b)
Value ..	Rs. 9,900	Rs. 7,000	Rs. 16,900	Rs. 910	Rs. 6,090 Rs. 9,900	(b)
					Rs.15,990	

APPENDIX IX.

Statement showing the value of sales effected through the Utilisation Division but accounted for in the accounts of the Supplying Divisions during the year 1951-52.

Source of supply.	B. G. sleepers.	M.G. sleepers.	N.G. sleepers.	Special sleepers.	Logs.	Poles and ballies.	Sawn timber.	Amount.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Buxa Division ..	87,625	80,304	1,500	80,857	1,34,421	..	33,759	4,18,466
Jalpaiguri Division	1,36,349	1,71,488	18,940	1,00,203	1,32,396	910	7,220	5,66,596
Kurseong Division ..	28,604	61,590	31,085	50,885	1,282	..	57,707	2,33,344
Kalimpong Division	..	42,217	3,340	..	..	..	..	45,557
Darjeeling Division	..	46,442	..	..	..	..	175	46,617
Cooch Behar Division	7,200	5,536	..	1,378	..	..	..	14,114
Total ..	2,59,778	4,07,577	54,865	2,33,323	2,68,099	910	98,860	13,23,412

9,55,543 3,67,869

13,23,412

APPENDIX X.

Quantity of timber, firewood, etc., disposed of locally from the forest areas direct to traders, Government Departments, or public bodies during the year 1951-52.

MAJOR PRODUCE.

Timber.									Firewood.	
Sawn.		Sleepers.			Posts, piles, poles and ballies, etc.		Logs.			
Quantity in ton.	Value.	No.	Ton.	Value.	No.	Value.	Quantity in tons.	Value.	Quantity in tons.	Value.
	Rs.			Rs.		Rs.		Rs.		Rs.
3,365	6,16,837	6,707	72·2	79,958	4,344	13,573	1,973,977	15,05,514	121,008	3,06,820

MINOR PRODUCE.

Honey.			Wax.			Charcoal.			Khair.				Miscellaneous produce.
Mds.	Sr.	Value.	Mds.	Sr.	Value.	Mds.	Sr.	Value.	Mds.	Sr.	Ch.	Value.	Value.
		Rs.			Rs.			Rs.				Rs.	Rs.
455,922	20	16,919	1,369	10	11,634	38,412	20	57,439	..	..	..	..	69,780

APPENDIX XI.

Quantity of timber, firewood, etc., disposed of locally to local consumers during the year 1951-52.

MAJOR PRODUCE.

Timber			Firewood.	
Sawn.	Poles, piles, posts and ballies, etc.	Logs	Quantity in tons.	Value.
Value.	Value	Value		
Rs	Rs.	Rs		Rs.
3,47,007	91,695	17,652	191,989	4,54,894

MINOR PRODUCE.

Khair.			Honey.			Wax.			Charcoal.			Miscellaneous minor produce.
Md.	Sr	Value.	Md	Sr.	Value.	Md.	Sr.	Value.	Mds	Sr.	Value	Value.
		Rs.			Rs.			Rs.			Rs.	Rs.
..	.	.	10	.	1,273	..	.	.	32,846	..	1,05,9..9	1,26,445

WBGP-53/4-3436C-00